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No.69: December 2014 £3.70

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in the hobby

HOW TO
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GUIDE



Starting with amphibians

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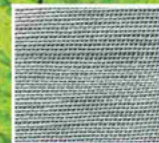
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December 2014

Welcome



Do film companies need to take more responsibility when portraying animals in their productions? This was a question that I'd hoped to discuss with Ian George, MD of Paramount Pictures UK, following the release of the latest *Teenage Mutant Ninja Turtles* film. Unfortunately, he doesn't seem keen to engage in dialogue on this topic.

The RSPCA has recently revealed the problems that can result from portrayals of animals in films and on television. Turtles are just one example. Indeed, when the *Harry Potter* films were released, there was an upsurge of interest by people keen to acquire owls.

It is not just films that can have this effect either. In the field of advertising, there has been an unfortunate demand for meerkats as pets, stemming from a well-known insurance campaign, and going back slightly further, red-eyed tree frogs were in the spotlight when they were used to promote a certain brand of American beer.

There is no easy answer to this type of situation of course. Nor does it just apply to what might loosely be termed exotics, but equally to dogs and cats. The RSPCA believes that television series like *Game of Thrones* may in part be responsible for the current upsurge in Akitas and wolf-type dogs that are being handed over into the care of rescue organisations. Again, people are seduced by the screen image, and fail to look deeper in whether or not such animals would be suitable for them and their lifestyle.

The encouraging news, however, is that this time round, interest in turtles has seemingly not increased significantly as a result of the film, which has had pretty poor reviews anyway. The trade has done what it can as well, to highlight the demands of keeping turtles as pets, by getting information into pet stores, with a poster campaign. We've included an article in this issue too.

David Alderton

David Alderton, Editor.
Email: prk.ed@kelsey.co.uk

David has extensive practical experience with this group of creatures, extending back over 40 years. He has written and broadcast widely about their care and biology, and his website can be found at www.petinclub.co.uk

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don't run the risk of missing out on your copy of *Practical Reptile Keeping* in future. Take out a subscription, and benefit from our special subscription offer.



Breeding Mr Grey



Monkfield Nutrition, one of the country's leading breeders of reptiles, is continuing its quest to unravel the genetics of the stunning bearded dragon called Mr Grey that cropped up unexpectedly in their breeding programme last year.

"He is a hypo translucent, and came from a translucent het hypo to a hypo het translucent pairing," says Peter Morris, Monkfield Nutrition's Senior Manager. "He displays the visual traits of both hypomelanism and a black-eyed translucent."

▲ Mr Grey is a completely unique example of his species at present.

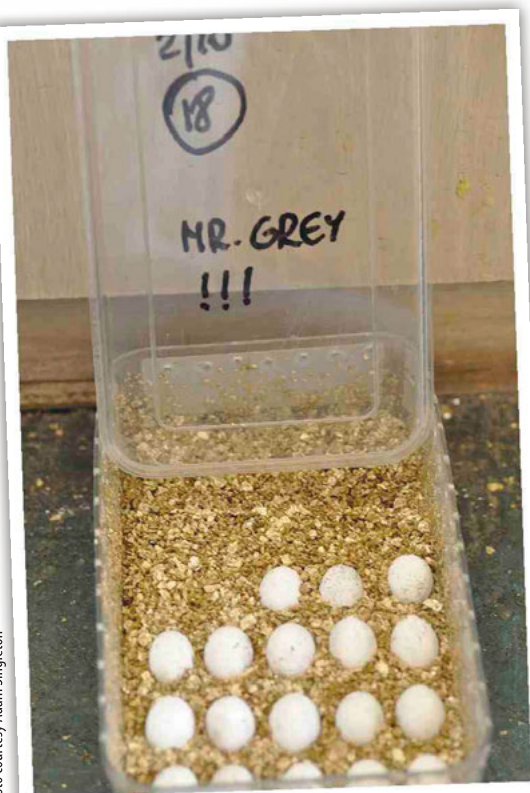
Peter and the team at Monkfield have been working on unravelling Mr Grey's genetics, based on their records, and deciding how best to pair him up. He has already been mated successfully with two females and although in neither case did the young resembled Mr Grey, they all displayed the visual traits of hypomelanism (a lack of dark pigment), as shown by their clear nails, and they are also heterozygous for the translucent trait too.

"We have now paired Mr Grey with one of his daughters and are waiting anxiously for the eggs to hatch. We expect to know more in the next couple of months, to see if any similar beardies to Mr Grey himself emerge in

this clutch. At the moment, all we can do is keep our fingers crossed, so watch this space!" says Peter.

Monkfield Nutrition has an extensive captive reptile breeding programme, producing not just bearded dragons but also leopard geckos, crested geckos, Yemen chameleons and colubrids. The UK's first commercial live food breeder, the company also produces top-quality live and frozen food to the trade.

**For more information about reptiles generally, follow Monkfield Nutrition on Facebook or at <http://www.monkfieldnutrition.co.uk>*



◀ The latest clutch of eggs.



Endangered frogs released back to the wild

One of the world's rarest frogs, bred as part of an international project to save the species from extinction, has been successfully returned to its Caribbean homeland. In total, 51 individuals of the critically endangered mountain chicken frog, native only to the islands of Montserrat and Dominica, have been released back onto Montserrat following a highly successful breeding programme at ZSL London Zoo.

The Mountain Chicken Recovery Programme is a partnership between Durrell Wildlife Conservation Trust, Zoological Society of London, North of England Zoological Society Chester Zoo, Nordens Ark and the Governments of Montserrat and Dominica.

Decimated by the spread of the chytrid fungus (*Batrachochytrium dendrobatidis*), and facing the very real threat of extinction, conservationists feared that the mountain chicken frog had been all but wiped out from the eastern Caribbean island. This reintroduction programme is regarded as a huge step forwards for the amphibians.

Ranking as one of the planet's largest frog species, the release of mountain chicken frogs on to Montserrat aims to not only boost the number of healthy individuals in the wild but will help conservationists from the Durrell Wildlife Conservation Trust and Zoological Society of London (ZSL) to learn more about their wild behaviour and the disease dynamics for this species. Fitted with tracking devices, the newly-released frogs are being monitored to gather further information that can be used to aid future conservation efforts.

In 2009, it was reported by conservationists from ZSL and Durrell that the wild population of mountain chicken frogs in Montserrat had severely declined due to disease, and urgent action was taken to safeguard their future. A small population of the last remaining healthy frogs was airlifted from Montserrat in a dramatic rescue mission.



Mountain chicken frogs were on the verge of extinction. Photo courtesy Tim Vickers, PD.



▲ The species is native to the islands of Montserrat and Dominica.

▼ The Mountain Chicken facility on Dominica. Photo courtesy Luke Harding.

Transported to three custom-built centres at ZSL London Zoo, Durrell in Jersey and Parken Zoo in Sweden, the 50 rescued frogs were the founders of the conservation breeding programme established to preserve and develop a healthy population of the animals,

which would have otherwise undoubtedly been destroyed by the fungal disease.

Following the incredible success of the breeding programme, which resulted in 76 frogs being produced from just two females at ZSL London Zoo in 2012, a group of the precious frogs was then reared at Durrell and ZSL London Zoo before their return to the Caribbean, where they were released in a protected area of the island's forest.

Ben Tapley, Head of Herpetology at ZSL London Zoo, explains: "Mountain chicken frogs are one of the most endangered animals on this planet - not only are they facing threats from habitat loss, but their numbers plummeted due to the introduction of the most devastating disease known to affect amphibians worldwide.

"The rescued frogs and their offspring were kept in a bio-secure, temperature-controlled breeding unit at ZSL London Zoo, to ensure a clean bill of health before their release back to their native habitat in the Caribbean."

Discussing the Mountain Chicken Recovery Programme, Jeff Dawson, Durrell's Amphibian Programme Officer, says: "The current release in Montserrat is the culmination of our four year long mountain chicken project on the island, and the team from Durrell and the Department of Environment has since been working tirelessly radio tracking the released frogs.

"The data collected will help our understanding around the dynamics of this disease in the wild which will be vital in guiding our future conservation actions for this amazing species."

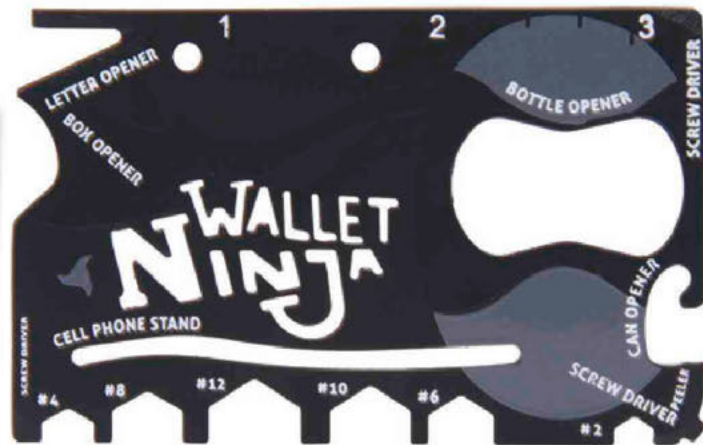


A multi-tasking tool

How often do you find that you're missing something like a screwdriver, ruler, phone stand or box opener when you're attending to your reptiles? Help is now at hand, enabling you to carry out these tasks and more.

Measuring about the size of a credit card, the Wallet Ninja 18-in-1 Multi-Tool can easily be kept in a wallet, to be used as and when required. This will help you tackle life's everyday battles, being very robust as it is forged from four times heat-treated steel.

* The Wallet Ninja 18-in-1 Multi-Tool costs £8.99 from www.firebox.com



NEW FROM EXO TERRA

Magic mushrooms

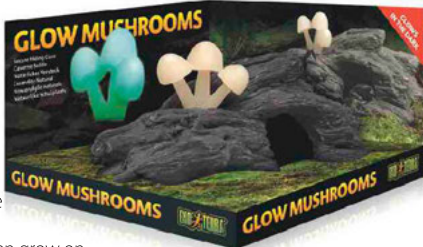
Aside from adding extra interest to a vivarium, the Exo Terra Glow Mushroom offer practical benefits too. In nature, decaying wood is regularly used by reptiles, amphibians and invertebrates as somewhere to hide, sleep or lay their eggs.

Bioluminescent mushrooms often grow on these decaying wood logs in the wild. Just as in nature, the Exo Terra Glow Mushrooms seem to grow on a decaying piece of wood. They absorb light during the day, and slowly release it again during the night.

The glow of the mushrooms creates a dim light in the enclosure, allowing crepuscular and nocturnal animals to see at night just as they would if the moon was out. The Exo Terra Glow Mushrooms also offer a safe spot for them to hide and sleep, while the moist microclimate that can be created inside this retreat will support effective thermo-regulation, hydration, and aid the natural shedding process of the vivarium occupants.

Key features:

- Provides a secure hiding place.
- Natural look, integrates in any type of vivarium.
- Great to create a humid microclimate.
- Ideal for use with the Exo Terra Scorpion Light.
- RRP £15.99.



Hiding off the ground

This new addition to the Exo Terra range creates a multi-level habitat. Tree-dwelling reptiles and amphibians are often reluctant to use ground-level caves for hiding or nesting, just as in the case of food dishes placed here. A proper hiding area is an essential feature of a natural vivarium. Without a safe spot to hide and sleep, reptiles and amphibians can easily develop stress that will affect their activity and appetite.

With access to an Exo Terra Canopy Cave, however, reptiles are able to retreat in this elevated and secure hideout, allowing them to rest in these surroundings. When filled with Exo Terra's Forest Moss, this unit is extremely suitable as a moist nesting hide where arboreal species may deposit their eggs.

A convenient clip system allows you to remove the hide and check for your animals or their eggs without compromising their nesting behaviour. A static-cling is included to cover the spy hole and darken the interior of the cave to provide more privacy when a vivarium occupant is using this retreat.

Key features:

- Arboreal nesting shelter.
- Perfect for arboreal reptiles and amphibians.
- Closable spy hole.
- Provides a humid micro-climate for hiding, shedding and egg-laying.
- Convenient, self-adhesive clip-system.
- RRP £11.99.



Feeding tree-dwelling species

It can be difficult to feed arboreal species, since tree-dwelling reptiles and amphibians are often reluctant to use ground-level food dishes. The Exo Terra Canopy Worm Dish is an elevated, worm feeder-dish that can be mounted at any desired height. Simply stick the self-adhesive clip to the glass of your vivarium and mount the feeder-dish to provide your reptiles constantly with invertebrates like mealworms.

It helps to prevent the escape of the occupants, while ensuring that they remain visible to the vivarium occupants. Mealworms need to be contained when they are placed inside the vivarium. If not, they will quickly disappear by digging their way into the substrate, and lose their vitamin coating rapidly.

The convenient clip-system allows you to remove the dish for a refill or cleaning without difficulty. The dish is constructed in two parts for this reason.

Key features:

- Elevated, escape-free, worm feeder-dish.
- Perfect for tree dwelling reptiles and amphibians.
- Great for rock-climbing lizards and geckos.
- Natural rock design, integrates in desert and tropical set-ups.
- Can be installed at any desired height.
- Convenient, self-adhesive clip-system.
- RRP £11.99.



Exo Terra Terrarium Décor Cleaner

This product has been carefully formulated to remove the most stubborn organic stains and odours caused by reptiles or feeder animals, without creating any risk to your pet reptile's health. It acts both as a cleaner and deodoriser.

Biodegradable ingredients, including naturally derived bacterial cultures and fermentation extracts, have been combined to remove a large range of organic stains and odours from all types of surfaces. These include cage carpets, Sand Mats, glass, resin and natural vivarium décor: water and feeding dishes, hiding caves, porous rocks, cork and wood, and live as well as artificial plants.

The natural composition of this cleaner is free from fragrance, VOC, NPEO, chlorine and organic solvents, and has the benefit of continuing to reduce odours in-between cleaning applications.

Key features:

- Eliminates organic stains and odours.
- Effective on all surfaces.
- Active formulation.
- 100% natural, free of fragrance.
- Safe and convenient.
- No environmental impact.
- RRP £8.99.



For more information on these and other reptile products, contact Rolf C. Hagen (UK) Ltd on 01977 556622 or visit the website at www.hagen.com

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DECEMBER 2014



CANCER IN REPTILES

There is no doubt that cancer in its many forms is a horrible disease, whatever species it affects. While cancer is clearly a big problem in terms of human health, and also for traditional companion animals such as cats and dogs, few people associate cancer with exotic species such as reptiles. Veterinary surgeon Tariq Abou-Zahr suggests it may be time to think again.

The truth is that few species escape it. As a vet with a special interest in exotic species, I can confirm that cancer in reptiles does occur and is not as rare as you might believe. Nor is it new. In fact, evidence of tumours has even been found in the fossilised remains of dinosaurs.

While our knowledge of cancer in reptiles is considerably poorer, compared with the situation in dogs for example, increasing cases are being documented, with reptile oncology (meaning the study of tumours) becoming more significant in the veterinary circles. Unfortunately, because cancer has such a low profile among reptile keepers at present, this means that symptoms may be overlooked by owners until it is too late. Time is always of the essence when dealing with cancer.

A case in a chameleon

A two and a half year old, male, captive bred Yemen (veiled) chameleon was brought into my surgery recently, having

▼ **Male veiled chameleons are very adept at changing colour, and this can give an indication of their health.**

been refusing food for two to three weeks, as well as being lethargic and showing signs of weight loss. For six months previously, a pale yellow mass had been steadily increasing in size on the animal's right flank. The owner had been advised several months previously, when the mass was considerably smaller, that it was likely to be innocuous and that no treatment was required at that stage.

The chameleon had undergone surgery five months previously with another vet to remove an area of necrotic (dead) skin present over the spine. Other than this though, there was no other medical history of note.

The owner had no other reptiles, with the chameleon being housed in a glass terrarium with a thermostatically controlled spot lamp to provide heat and a separate 10% UVB lamp. A vertical thermal gradient was provided in the chameleon's quarters, with a basking temperature being maintained around 30°C (86°F).



A veiled chameleon with mouth open, engaging in a threat display.

Surgery goes ahead

It was decided to admit the chameleon for surgery to remove the mass on that same day. The operation was fairly straightforward and involved giving the chameleon some drugs by injection for pain relief a few hours beforehand, then anaesthetising it with an anaesthetic gas.

The surgical site was scrubbed to ensure it was sterile with an alcohol-free iodine solution. A local anaesthetic was injected around the mass to ensure as much pain relief as possible. Afterwards, the skin was sutured back up with absorbable sutures.

During the surgery, the chameleon had to be maintained on a ventilator as reptiles lose the ability to breathe by themselves whilst under general anaesthetic. Thankfully, it was a fairly short procedure, taking about 15 minutes in total. The chameleon was able to recover breathing room air as opposed to oxygen. Unlike the situation with mammals, it is a falling oxygen level (not rising carbon dioxide) that stimulates reptiles to breathe.

The results

After its removal, the mass was sent away to an external laboratory specialising in exotic species, to be examined by a pathologist. The report came back a few days later. Sadly it was not good news. The mass was a malignant tumour and appeared to be a melanophoroma, a type of tumour of the cells involved in skin pigmentation that contain the black pigment, called melanin.

It was likely, based on the clinical signs and the length of time that had passed since the swelling first appeared, that the cancer had already spread. With this in mind, the chameleon's owners decided to take their pet home, coming to terms with this bad news, and when they were certain that its quality of life was reduced, they would return with it.

As it happened, the chameleon had to be euthanased just a week after the

▼ Reptiles need help to keep them breathing during surgery.



Food items were dusted with Nutrobal and offered in a suspended bowl within the enclosure. While the chameleon had previously eaten a varied diet of insects, including crickets, locusts and waxworms, the only food that it had shown any interest in were waxworms, with its appetite having fallen significantly. It had also become much less active and its owners reported that it had lost a lot of weight. Nevertheless, its husbandry seemed pretty good overall.

Clinical findings

A physical examination of the patient then revealed a markedly thin chameleon, although it was bright, alert and responsive. When taken out of its carrying box, it assumed a full threat display, which included opening its mouth in a threatening way, and a change in colour from an overall drab brown/dark green shade to vivid shades of green and white. It was very capable of gripping my hand.

Aside from the poor body condition, the only abnormalities detected were the swelling on the right flank and an area of scar tissue over the back, following the surgery that had previously been carried out. This looked to have healed well. The dimensions of the mass on the right flank were approximately 0.5x0.5cm (0.2x0.2in).

In most cases, it is impossible to say for certain what precisely may be involved in a lump without having a look at the cells under a microscope. Sometimes though, you can get a good indication, based on its general characteristics. I have to admit that this mass to me did not appear as if it was going to be particularly nasty!

My instinct was that the histopathology (looking at a section of the tissue under a microscope) would reveal that it was benign. It did not look to be invasive locally, as is typical of cancerous growths on the skin. Instead, it had clear borders and I was pretty sure that after removing it, that would be the end of the problem.

arrival of the histopathology results. The owner reported that by this stage, the chameleon had become truly anorexic and was regularly falling off branches as it tried to climb around its quarters.

A subsequent post-mortem examination revealed black circular areas present in the liver, stomach and lungs, consistent with metastases to these organs, revealing that the cancer had indeed spread. Other organs appeared unaffected, but the chameleon's fat stores were severely depleted.

An increasing incidence

Cancer in reptiles is being diagnosed with increasing frequency. It has been suggested that in lizards, between 3-6% are likely to be affected. There are various types of tumour affecting the integumentary system (skin). These have included papillomas (warts) and melanomas, as well as squamous cell carcinomas and lymphosarcomas, to give just a few examples.

Cancers affecting pigment-producing cells in the skin are also known. Chromatophores, as these cells are collectively described, are divided into four different groups - melanophores, iridophores, erythrophores and xanthophores, with cancers affecting these cells being described as chromatophoromas in general, or by individual "-phoromonas".

A study published in 2011 highlighted 26 cases of chromatophoromas in reptiles, including two examples in veiled chameleons. One animal, a one year old male, was determined to have an iridophoroma. The other, a three year old male, was found to have a melanophoroma, although these are rare.

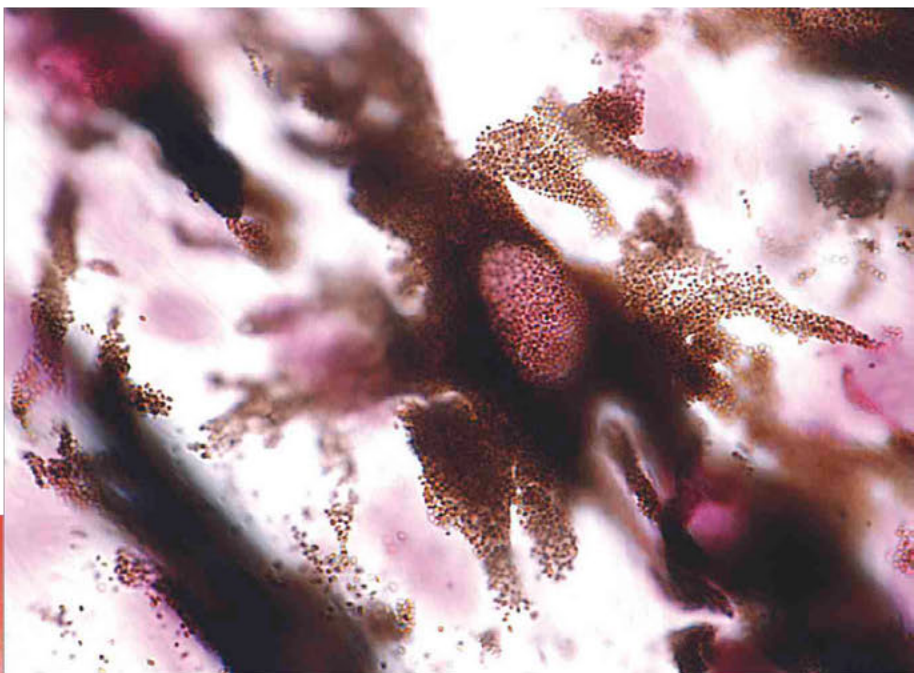
It is interesting to consider the similarity in age and sex between the chameleons in this case, which was a two and a half year old male, and the animal with the melanophoroma included in this report, which was another male, age three years old. The outcome in that case



▲ Could melanophoroma be a form of cancer to which male veiled chameleons are most susceptible?

► A highly magnified chromatophore, showing the dark melanin pigment. This is normal tissue.

▼ The chameleon's cancer had spread, metastasising to other organs via the blood stream.



was that again, there were black spots in the organs where the cancer had spread. In this case, the heart, lung, tongue, stomach, gut, liver, spleen, kidneys, bone, fat bodies, parietal serosa of the coelomic cavity and the brain were all affected, with these organs being blackened in appearance.

Although there may be few recorded case reports, it has been suggested that it may not be correct to assume that chromatophoromas in reptiles are, however, infrequent. It may simply be that they are not being detected at

present. A technique called immunohistochemical analysis has been used to characterise chromatophoromas in reptiles.

Indeed, melanophoromas in particular have been reported in several reptile taxa. These include Hermann's tortoise (*Testudo hermanni*), yellow anaconda (*Eunectes notaeus*), pygmy rattlesnake (*Sistrurus spp.*), southern water snake (*Nerodia fasciata*), veiled chameleon (*Chamaeleo calyptratus*) and leopard gecko (*Eublepharis macularius*), as well as the green iguana (*Iguana iguana*).



By the time that the veiled chameleon that I saw was brought in for treatment, it could not be cured, given the nature of the cancer that was subsequently identified. In other cases, however, surgical intervention has been successful, before the disease can spread to the reptile's vital organs.

Treatment

Reptile oncology (the study and treatment of tumours) is still very much in its early days. Several different classes of chemotherapy drugs have, however, been safely used in reptiles. Yet, to my knowledge, there has been no reported attempt to treat a melanophoroma with medication of this type. Whether this is a

potential treatment option remains to be seen, although chameleons are by nature prone to stress and they may represent poorer candidates for any kind of ongoing treatment in comparison with other species such as bearded dragons.

Although wide surgical margins are taken with any suspect mass where possible, to ensure the tumour is fully removed, radiation therapy can be utilised for treatment of any residual diseased tissue remaining after surgery. Indeed, radiation therapy was used back in 1991 in the treatment of a malignant chromatophoroma in a yellow rat snake. Four fractions of radiation were provided over a 15 day period and the only side effect observed was the appearance of

▲ Melanophoromas have been recorded in a variety of species of reptile, including Hermann's tortoise.

some dry "lacklustre" scales in the area being treated.

What to do

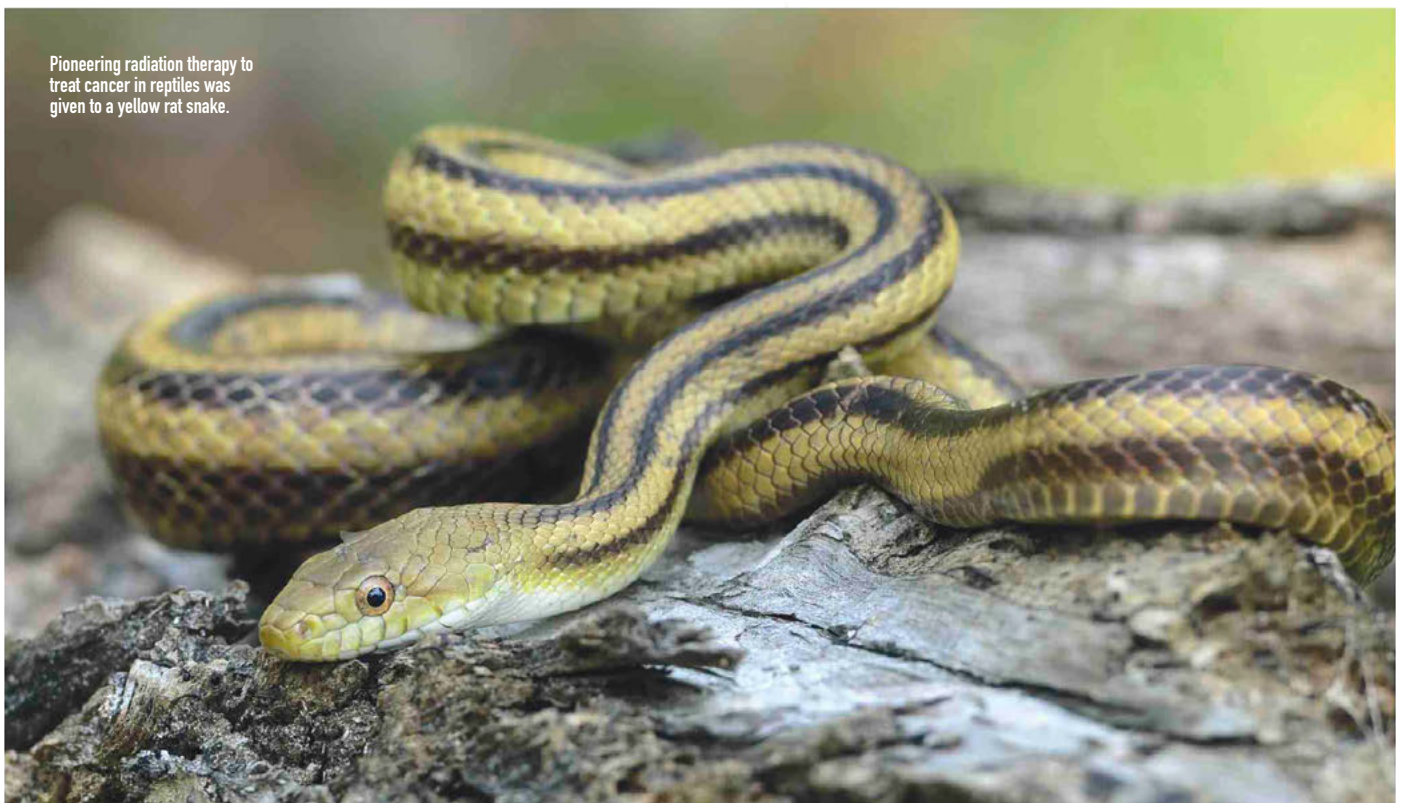
Cancer in any creature is often hard to come to terms with. Veterinary surgeons are arguably lucky that the option of euthanasia is available. The decision about quality of life is always a difficult one and depends very much on the species in question. In the case of chameleons, which are animals prone to the negative effects of stress, we are limited as to how far we can go with them from a treatment and supportive care point of view.

For example, a veiled chameleon that requires supportive daily feeding is likely to find this more stressful than a tortoise. Therefore in certain species, the decision to euthanase on welfare grounds may have to be made earlier than in others.

There needs to be more widespread appreciation that cancer is a problem that does afflict reptiles, although at present, it is often not given much thought. Any lumps, bumps or swellings that develop on the body of a pet reptile must be checked by a vet. Do not simply dismiss these as innocuous. If treatment is sought early on, there is the possibility that a tumour can be removed successfully, before any cancer cells have the opportunity to spread to other more vital organs.

Nevertheless, it is also important to be aware the treating cancer in reptiles is expensive. Surgery itself is not cheap, and more advanced treatments such as radiotherapy are going to add

Pioneering radiation therapy to treat cancer in reptiles was given to a yellow rat snake.



Think seriously about insuring your reptiles, in terms of veterinary costs, and seek advice early, to maximise the chances of successful treatment.

It never ceases to amaze me how few reptile owners have considered pet insurance for their animals, or even know that pet insurance is available for these types of animals!



significantly to the cost. This to me is good justification for getting these types of animals insured.

It never ceases to amaze me how few reptile owners have considered pet insurance for their animals, or even know that pet insurance is available for these types of animals! If a reptile is a much loved pet, then for goodness sake, get it insured so that if anything like this happens, financial considerations are not something that has to affect the decision making process.

Also, if you do find yourself in the unfortunate position of having a reptile that is suffering from cancer, do consider allowing your vet to write up the case. There is very little information published on cancer in these animals as I say, and at least other clinicians may learn from the findings, so that at least some good can come out of what is clearly a very bad situation. If your vet is not proposing to write it up and it is something genuinely unusual, try to persuade him or her to do so, as it can then be referred to by others seeking information in the



▲ Keep a close watch for any abnormalities around the eyes of bearded dragons.

veterinary literature. It could even save the life of other reptiles.

Cases in bearded dragons

Specific types of cancers are gaining notoriety in certain species. For example, in bearded dragons, cancers around the eyes of older animals are becoming an all-too-common occurrence. While several years ago, these “peri-ocular neoplasms” were seldom reported, it is a symptom of better standards of care and the resulting longer lifespan of lizards (just as in humans) that is at least partially responsible for more cases of cancer.

Any swelling around the eye of a bearded dragon should always be taken very seriously. Some of these tumours can be quite nasty indeed, and treatment is challenging as any surgery will have to be performed in a very delicate area. While various treatments have been tried, including topical chemotherapy creams, surgical excision remains the treatment of choice for these types of tumours at present.

In conclusion

If you notice a lump, or you can feel something unusual inside the belly of one of your reptiles, it is possible that cancer may sometimes be the cause. When you first acquire a pet reptile, register with a local veterinary surgeon who is familiar with exotic species, so that if any health issues do occur, there will be no delay in providing your pet with the prompt medical attention that will be required. This can literally mean the difference between life and death. ❖

Further information

Tariq Abou-Zahr BVSc MRCVS is a veterinary surgeon with a special interest in exotic species, as well as being both a keen herpetoculturist and aviculturist. He is available for consultation for all first opinion exotics cases, and currently practices at Summerhill Veterinary Centre, 43 Summerhill Avenue, Newport, South Wales. NP19 8FQ. 01633 255394.

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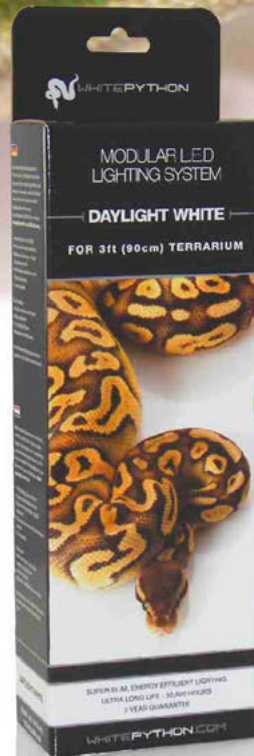


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Out of Africa

The importance of invertebrates

In the concluding part of his series looking at how reptiles, amphibians and invertebrates benefit our lives – often in surprising ways – Paul Donovan concentrates here on insects and arachnids.

Technically, this article should refer to arthropods in general, as this diverse group of organisms have a major impact on

the eco-system around us and our lives, embracing crustaceans such as crabs, brine shrimp and barnacles, as well as millipedes and centipedes too, but I will concentrate here just on the insects and arachnids (spiders, scorpions and their relatives), which are most widely-represented in collections.

In fact, by far the largest group of living organisms on earth today is the insects. With almost a million species classified so far, they represent roughly 80% of the total number of species on the planet. This may sound an astonishing figure, but it is actually only the tip of the iceberg. Some scientists estimate that the true total of insect species lies somewhere between 2-30 million.

People have only really just begun to explore the forest canopy over the past decade, and this is revealing an entirely



▼ The rainforest canopy in different countries around the world is host to millions of undiscovered invertebrates.

new and basically as yet largely unstudied eco-system. And as we push deeper into hitherto unexplored jungles, more amazing insects and arachnids are coming to our attention. But as is so often reported – we are destined to be wiping out species before they have even been discovered, by destruction of their habitat.

With such a wealth of diversity, it stands to reason that these groups of organisms influence our existence in many different ways. Let's take a look at a few of these, and why insects and arachnids are so important to us.



Pollinators

Without any doubt, the greatest benefit that insects offer us, and the eco-systems that they inhabit, is by acting as pollinators. Without the bees, butterflies, bugs, certain types of beetle, wasps, flies, and some species of ants, we would not be enjoying the varied diet that we eat today. You may not realise that almost 90% of the fruit and vegetables that we eat on a regular basis have been pollinated by insects. As I sit here in Botswana, looking out of my living room window at the citrus trees growing in my garden, were it not for many of the insects visiting them, I would not be enjoying freshly squeezed orange juice, or a grapefruit for breakfast.

With a few exceptions, just about every species of plant has evolved colour or scent to attract insects. The process is very simple. As insects visit flowers in search of energy-giving nectar, so pollen sticks to their bodies. As they then move from plant to plant, this pollen is spread around and deposited on the stamens of the flowers, allowing pollination to occur.

Do not assume that all plants produce sweet smells to attract insects though. I have a species of cacti growing in my garden which, when it flowers, stinks like rotting flesh! Its pollination relies on flies that are attracted to such odours.





Ladybirds are important predators of insect pests. Photo courtesy of the author.

We should be looking after pollinating insects by using fewer insecticides, because otherwise, our diet could become very bland in a very short space of time. The value of insect as pollinators of crops such as coffee, tea, cocoa (how would we survive without chocolate!), fruits and nuts is estimated to be in the region of US \$117 billion (£70 billion) per year.

Natural predators

As we grow more crops to feed the world's growing population, inevitably these will attract some insects that will feed on them. In turn though, these injurious insects are hunted by other invertebrates, and sitting at the pinnacle of this predatory tree, often literally, are the spiders. Supremely camouflaged in most cases, these assassins help to keep in check many pest species such as flies, grasshoppers, bugs and the like.

Other insects that are important pest controllers include ladybirds, tachinid flies, assassin bugs, and preying mantises. There are also so-called 'parasitoids', such as some species of wasp that lay their eggs in fellow invertebrates, with the resulting larvae feeding on and ultimately killing their host in this grisly way.

Predatory insects represent an increasingly significant tool in the farmer's armoury, as a means of naturally controlling pests without resorting to chemicals. Biological pest control is also being used increasingly by gardeners too. In monetary terms, the value that these bio-pest control species provide is estimated to be in the region of US \$400 billion (£251 billion) per year.

Praying mantises are highly effective predators of potentially harmful insects such as aphids.

As food

Insects are a rich source of protein, and in many countries are eaten as a source of food. Here in Botswana, we eat the caterpillars of the mopane moth. They have their innards squeezed out, before being salted and left to dry in the sun. They can then either be eaten as they are, as a snack, or cooked with tomatoes, onions and greens in gravy and eaten with papaya.

In other regions of the world, scorpions, spiders, locust and the like are also served up as delicacies. Insects are extremely easy to breed, and while people in Europe and North America may balk at the thought of eating creepy-crawlies, if we could 'repackage' them into looking more appetising, they could provide a cheap source of protein, and eliminate food supply problems in many impoverished countries that suffer debilitating droughts.



▲ Biological pest control also includes using chemical messengers, called pheromones, (which are normally emitted by the insects themselves), to attract harmful species to traps.

Recyclers

The importance of invertebrates as recyclers, and their resulting benefit to humans should not be underestimated. The humble dung beetle, as it buries its dung ball, is not only putting nutrients back into the ground, but is also indirectly helping to keep down the fly population, lowering the risk of the spread of diseases; the less dung there is laying around, so the less opportunity that exists for flies to lay their eggs in it.

The likes of cockroaches, millipedes, carrion beetles, ants and termites, also help recycle literally thousands of tons of animal and plant material back into the soil. And the more fertile the soil, the more productive crops we can grow. In addition, this helps trees to grow which in turn absorb carbon dioxide, and give off oxygen that sustains life. The value of nutrient recycling by insects is estimated to be worth in the region of a staggering US \$3 trillion dollars (£1.88 trillion) per year.

Clothing

Did you know that the expensive silk shirt, scarf or blouse you spent a fortune on buying is nothing more than caterpillar spit? The utilisation of silk can be traced back to China over 4000 years ago. Legend has it that an emperor experimented making cloth from the silk thread. This proved to be so successful that 4000 years later, silk is still being used to make clothing.

The silkworm (which is in reality a caterpillar and not a 'worm') represents the larval stage in the lifecycle of the silkmoth, typically the species known as *Bombyx mori*. It produces a continuous unbroken length of silk that it spins into a cocoon, as the time for pupation approaches. These silkworms are farmed for their cocoons, which are then

▼ Weaving silk in Vietnam. Note the baskets of cocoons.





▲ The silkmoth has now become domesticated.

Did you know?

Each cocoon consists of a thread of raw silk that can be up to 900m (3000ft) long. It can take 3000 cocoons to manufacture 0.4kg (1lb) of silk.

unravelling and spun into luxurious clothing.

Selective breeding over the years to produce a larger silkworm, and in turn more silk, has resulted in a silkworm far removed from their wild ancestor. These silkworms are now unable to climb the plants upon which they feed, and so are totally reliant on humans to provide food for them. China, which is where silkworm farming (or 'sericulture') began, is still the world's biggest producer of silk, with its output accounting for approximately 80% of the market.

Water monitors

Just as with amphibians, insects can be reliable indicators as to the state of water pollution. When insects are found in and around rivers, streams, lakes and ponds, we can be pretty sure everything in that eco-system is functioning well. The absence of insects should give us cause for concern, as it implies an unhealthy eco-system.



▼ Honey and beeswax are important ingredients in our lives that are produced by bees. In Africa, honey is collected from wild hives.

Silkworms and their cocoons seen in close-up.



One of the major causes of human mortality in tropical areas, such as here in Africa, is malaria, spread by mosquitos. Once again though, there are insects that will help to keep these potential killers in check. Dragonflies are especially beneficial in this respect, because their predatory nymphs will kill the mosquito larvae in the water, and the adult dragonflies will then prey on mosquitos once they too have left the water and are flying.

Producers of honey

For over 20 million years, bees have been producing honey, and from our first tentative footsteps on the planet, humans have enjoyed it. Although honey is often promoted as a medicinal cure for many ailments, including cancer, coughs, and allergies, no scientific proof exists for such claims. Nevertheless, manuka honey, collected by bees in New Zealand, is used to dress wounds and ulcers, being known to have anti-bacterial properties.

In addition to honey, bees are also



Pollen is another by-product produced by bees that is used as a human foodstuff now.

Did you know?

There are estimated to be 10 quintillion (that is 10,000,000,000,000,000!) insects alive on earth at any one time.

important for making beeswax, with Britain importing over 450,000kg (990,000lb) of it each year. While most of this goes into making beeswax polish, it is also an important ingredient in skin creams and lipsticks.

For over 20 million years, bees have been producing honey, and from our first tentative footsteps on the planet, humans have enjoyed it.





A cream made from blister beetles is used to treat warts and other skin ailments. Photo courtesy Nuberg13/PD.



▲ A highly magnified shot of cochineal-producing scale insects on a citrus tree.

Dyes

Insects also play an important role in the colourings of many everyday items. The sticky secretion from the Indian lac scale insect (*Laccifer lacca*) is used in the manufacture of shoe polish, floor polish, varnish, printer ink, cosmetics, wool dyes, and various other products. To give this trade some perspective, India exports approximately 17 million tons of lac each year.

Shellac, scraped off trees where it is deposited by female lac bugs, was formerly widely-used in the manufacture of furniture. The dry resin is mixed with alcohol in the form of ethanol, to break it down into liquid shellac, which can then

be painted on to wood.

It can be used as a stain and varnish too, being very effective at excluding moisture. Perhaps the most remarkable use of shellac, however, was for the manufacture of the first gramophone records, called 78s, lasting through until the 1950s.

Possibly the best-known insect dye, however, is cochineal, which is processed from the scale insect (*Dactylopius coccus*). With its blood red colour, it is widely used in the textile and cosmetic industries, with insect-derived dyes having been incorporated in products ranging from cake colouring to medicine. Tannin, used to tan hides, is a dye originating from insect galls.

Medical treatments

The use of insects in medicine has been practiced since antiquity. Possibly the most recognised of these is the wound-cleaning properties of maggots. During the Second World War, they were routinely used to treat infected wounds. Even today, maggots are still used in some medical situations. In 2007, they were trialled in patients suffering from the MSRA flesh-eating bacteria *Staphylococcus aureus*. This bacterium is resistant to most antibiotics, but remarkably, the resulting infection can be slowed down by introducing maggots to the wound. These then eat the necrotic (dead) tissue.

While on the subject of bacteria, did you know that the Madagascan hissing cockroach has become an alternative model for bacterial studies? These cockroaches have well-developed immune systems and can give acceptable blood and tissue samples for analysis. It has also been discovered that they possess Toll receptors similar to those of mammals. Toll receptors are responsible for recognising foreign invaders in the body and activating the immune and inflammatory systems that will attack them.

Bioluminescence (which is the ability of some insects and other organisms to produce light) has been successfully used



Madagascan hissing cockroaches – as kept as pets – are also being used for medical studies.



Different colours of shellac resin. Photo courtesy Nuberg13/PD.



to detect certain diseases, such as various forms of cancer. Also in the medical field, a cream made from the bodies of blister beetles has been developed for the treatment of warts and other skin ailments.

The venom of bees and scorpions has been found to have anti-inflammatory properties that can be used for the treatment of arthritis. I have a friend who suffers from arthritis in the joints of his fingers. Rather than using conventional treatments, he regularly allows a small species of *Uroplectus* scorpion found here in Botswana to sting his fingers. He says that it brings "days of relief", to quote him!

Genetic research

The rather humble and innocuous looking fruit fly, known scientifically as *Drosophila*, may account for hundreds of millions of dollars of loss each year to the fruit growing industry, but without its existence, our understanding of genetics would not be where it is today. It is an ideal study tool, as it has a short lifespan (about 10 days) that allows researchers to study tests over several generations in a short period of time. The genome of *Drosophila* was sequenced in 2000, and since then it has paved the way for research into a better understanding of human diseases, remarkable as this may sound.

In 2001, scientists at the University of California identified 548 genes in fruit flies that had counterparts to genes that are responsible for over 700 different genetic diseases in humans. As the flies have four pairs of chromosomes, are easy to breed and look after, and lay numerous eggs, so this has enabled

▲ *Drosophila* can be easily bred in the laboratory, and they have proved ideal subjects for genetic research.



▲ Cameras are being developed that mimic the compound eyes of certain insects. Photo courtesy of the author.

▼ There is no doubt as to which insect provided the inspiration behind this particular camera.



A glow-worm – perhaps the best-known of the insects capable of generating bioluminescence. Photo courtesy Wolf.



scientists to manipulate their genetic makeup and observe the results in a very short period of time.

The flies have enabled huge inroads to be made into our understanding of disorders such as Parkinson's disease, Alzheimer's disease, diabetes, and cancer to name but a few. They have also given us further insights into the aging process.

Technology

Technology is using the insect model to develop tiny cameras that can mimic the compound eyes of certain insects allowing surgeons to carry out even more delicate operations. The US military has now designed a spy camera resembling a dragonfly. It could fly unnoticed into a hostile area and relay back vital information. A camera inspired by the fly has also been developed to allow search and rescue

teams to find trapped disaster victims quicker than conventional methods of search and rescue.

Tail-end

I have always been passionate about insects, spiders and scorpions. As I sit out on my veranda at night with a cold beer in one hand and a can of mosquito repellent in the other listening to the chorus of chirping crickets, I'm so glad that the days I spend exploring the bush are filled with so many amazing bugs. Without them, the earth would be a very different place indeed. ❖

Did you know?

Spider silk, being five times as strong as steel of the same thickness, has the potential to revolutionise many spheres of human existence. If we can unlock the secrets of how it is made, and then manufacture it on an industrial scale, it has the potential to be used in medicine, the construction industry, and also by the military. It has already been investigated as potentially being useful to create extremely strong, lightweight bulletproof vests.

I always worry with winter looming that I could be left without live food for a period, should the weather turn bad for any length of time, *writes Richard White*. With this in mind, I'm just setting up a breeding culture of morios now.

These are a very popular livefood for larger lizards, but the consensus is they should not form the staple of the diet, partly because of their hard exterior. Although morios are not well-balanced in terms of their calcium:phosphorus ratio, with gut-loading therefore still being essential, this figure is about twice as good as that of mealworms (*Tenebrio molitor*). They also contain more fat and protein than mealworms.

There is often confusion about morios (*Zophobas morio*), in that they are frequently described as giant mealworms, but they actually belong to a separate genus. Nonetheless, the three stages in a morio worm's life are exactly the same.

The so-called 'worm', which is actually the larval stage in the lifecycle, will ultimately pupate, and the adult beetles hatch from the pupae. Before long, they should start breeding and laying their eggs, which then completes the lifecycle.

Housing

The easiest way to accommodate morio worms for breeding purposes is to get a drawer stack, like the one pictured, which was £7 from Asda. An important point of distinction with mealworms is that morio worms will only pupate if they are kept isolated from others.

They will not turn into beetles if kept in a communal tub. For this reason, you need to separate them. I went to Hobbycraft and bought a few compartmentalised containers, and then used a tub of the morio worms that I had purchased from my local reptile store.

To begin, put one worm in each compartment of the container, and place the container somewhere



Morios will not complete their lifecycle if kept together.

BE PREPARED!

warm. An airing cupboard will suffice, but I have mine above the heat source of my bearded dragon's vivarium. Be careful there is no fire risk at all though.

Don't offer any food to the larvae at this point, just leave them be. Over the next week or so, you will notice that they start to curl up, and soon after that, they will turn into pupae, being rather reminiscent of something from the film *Alien* at this stage.

Transfer the pupae into the drawers then, after lining these with a layer of oats. Before long, you will have some beetles. These should be gut-loaded like any feeder insect, and chopped potato provides a good source of hydration as well as food.

The next generation

The beetles do not live very long, perhaps a couple of months, and it is crucial to remember that you will not see the baby worms initially – they are far too small. For this reason, it is best not to do any cleaning out other than spot cleans. However, there are two ways to go about sorting the babies.

Option one is simply wait for the beetles to die, then leave the babies to grow in the same drawer. Any new beetles should be put in a new drawer. The second option represents slightly more work: cut a hole in the bottom of a drawer and place fine mesh on the underside. Then place this directly on top of another drawer.



Above: A difference in size – a morio pupa alongside a pupated mealworm (bottom).

Left: A compartmentalised container is needed to encourage pupation. Photo courtesy of the author.

The babies naturally burrow down and are small enough to drop through the mesh, so they will separate themselves from the beetles. You can then clean out the drawer with beetles safely.

Eventually, you will have three drawers: one with beetles, the second with baby morio worms, and the third with adult morio worms. This should provide you with a way of feeding your lizards without worry, if postal deliveries cease and your local livefood supplier runs out of stock as the result of a spell of snowy weather this winter. ❖



A stack provides versatile accommodation. Photo courtesy of the author.



A beetle starts to hatch after its period of pupation.



Morio beetles mark the start of the next generation.

SHOP PROFILE

Featured this month

This month, we profile The Living Rainforest and internet supplier Rainforest Reptile Supplies, based in North Wales.



It's been 10 years since The Living Rainforest first opened its doors to the public. Remember 2004? It was the year that Facebook launched, the last episode of *Friends* was broadcast and the global financial crash had yet to happen. "I'm really grateful to our loyal customers – that's why we're still here, in spite of all the ups and downs," says owner Steve Gill.

An invitation to join the party!

As a way of showing his appreciation to the local community in the Welsh seaside town of Rhyl, Steve is planning a party with a difference at the shop, for the first weekend in the New Year, which will be January 3rd and 4th.

"I've decided to organise a charity fundraiser," he explains. "There will be a host of prizes on offer, with more than £2,500 already donated by companies including Peregrine and ProRep, Arcadia, ExoTerra, Zoo Med, Lucky Reptile, Wild Republic, Habistat, Sky Pets, White & Carter and Inverburn. Raffle tickets are on sale now at £1 each, and there will be a tombola running all weekend with lots of great prizes too, as well as many great in-store discounts."

Amongst the visitors dropping in on The Living Rainforest over the weekend will be a Cuvier's dwarf caiman. All money raised on the weekend will go to the St Kentigern Hospice (<http://www.stkentigernhospice.org.uk/>), which is a local charity, hoping to extend their present eight bed care unit to 20.



Changing times

Looking back on his years since he started in the business, Steve has noticed a number of changes. "Customers are generally much more informed when they come into the shop these days. They are more likely to know what they want. In the case of tortoises for example, it's clear that people are aware that not all of those available require hibernation."

"There actually appears to be growing interest again in tortoises as pets. People may feel more comfortable now, caring for small, captive-bred young tortoises rather than the adults that used to be imported in the past. The available equipment has dramatically improved, making it easier to ensure they are receiving the best possible care."

"Horsfield's are very popular, followed by Hermann's. We usually have quite a wide range available, and also stock tropical species such as red-foots and leopard tortoises."

As is the case with most retailers, Steve is reluctant to stock sliders and cooters, because of the size that these turtles can grow. Instead, he has set up an attractive in-store display featuring Reeves' turtles, which only grow to about 15cm (6in) long when adult.

Another area that has changed over the years since he started out is the field of royal (ball) pythons. "In the early days, people were happy to spend hundreds and sometimes thousands on the rarer morphs, and so we regularly kept some higher end morphs in stock" he explains. "There just isn't the money around for them though today, at least where we are, and we therefore tend to order them in specifically for customers instead."

"Tarantulas seem to be becoming more popular now though, and we always have an extensive range of stock, covering all exotics, for visitors to see. This helps to draw customers from a wide area."

Advice on-hand

Steve also operates an on-line store, for those unable to visit the shop in Rhyl. He finds this attracts both newcomers to the hobby, as well as regular purchasers, keen to acquire live foods and dry good at keen prices, backed up by dependable customer service.

"My aim is to offer the best of both worlds," he explains. "People setting up can buy a complete vivarium and all the equipment in this way at a discount, and better still, if you are uncertain about what to order and want advice, an experienced member of the team is just a phone call away. We're always happy to help with all queries."



Plan a visit

Where: The Living Rainforest, 4 St Margaret's Buildings, Rhuddlan Road, Rhyl, Denbighshire, North Wales LL18 2HT. Tel: 01745 353411.

Websites: The Living Rainforest (shop) <http://www.the-livingrainforest.co.uk/living/index.php>
Rainforest Reptile Supplies (mail-order goods) <http://www.rainforestsupplies.co.uk/lrf/>

Opening times: Monday 10am-2pm; Tuesday-Saturday 10am-6pm; Sunday 11am-4pm.

Getting there: The shop is located directly on the A525, just before Pandyffryn Road, heading up towards the coast.

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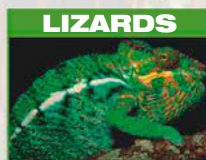
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Starting with amphibians

Oriental fire-bellied toad.

An increasing range of amphibians are now being kept and bred today. With proper care, these animals will thrive in collections and can live surprisingly long lives: some species have a life expectancy of well over 20 years. James Brereton explains some of the main points that you need to consider when keeping these fascinating animals.

Why amphibians?

There are over 6,000 species of amphibian alive today, including frogs (Anura), salamanders (Caudata) and the rarely-seen caecilians (Gymnophiona). Species kept as pets range from the petite golden mantella (*Mantella aurantiaca*) to the enormous Argentine horned frog (*Ceratophrys ornata*). Many species are relatively cheap to acquire, with the Oriental fire bellied toad (*Bombina orientalis*) and the African clawed frog (*Xenopus laevis*), not to mention Japanese or Chinese fire-bellied newts (*Cynops* species) often being recommended for those starting out.

At present, amphibians are facing a wave of extinction due to the deadly fungal infection called chytridiomycosis (*Batrachochytrium dendrobatidis*), which is often simply referred to as chytrid fungus. It is a disease that has, in just a few years,

Chinese fire-bellied newts are very easy to keep.

toppled entire species over the brink of extinction. These include Rabb's fringe-limbed tree frog (*Ecnomiohyla rabborum*); in this case, only one individual, a male nicknamed "Toughie", is known still to be alive.

Other species, such as the Panama golden frog (*Atelopus zeteki*) now exist only in collections. With this

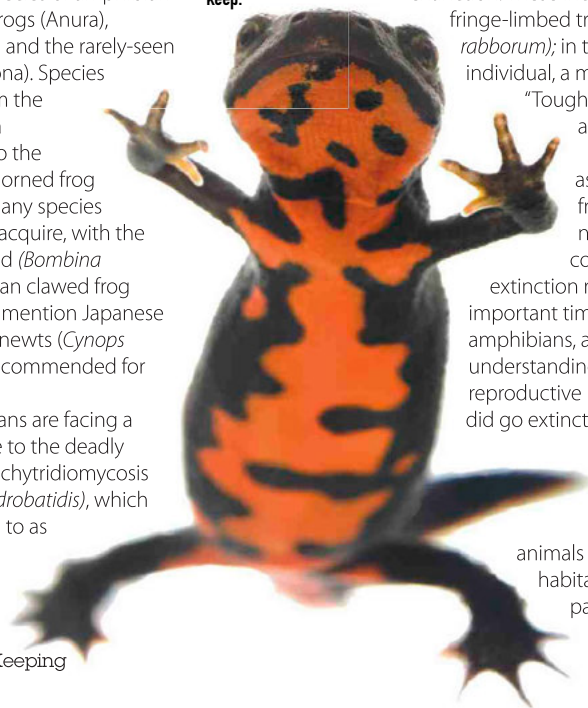
extinction risk in mind, it is an important time to keep amphibians, and increase our understanding of their reproductive biology. If a species did go extinct in the wild, a carefully monitored captive population might one day be used to reintroduce the animals back to their natural habitat. This would be particularly significant if

the threat of chytrid can be overcome, with many scientists working to make this happen as soon as possible.

Another reason for keeping amphibians is simply that there is still much still to be learned about these unusual animals in terms of their behaviour and breeding. There are various mysteries surrounding the triggers for breeding certain amphibians, and keeping these creatures can certainly help to reveal these secrets.

It is now known that the mountain chicken (*Leptodactylus fallax*), for example, lays its eggs in a carefully constructed burrow, and feeds the offspring by returning daily to lay unfertilised eggs. This peculiar rearing system was first discovered at Durrell Wildlife Conservation Trust in Jersey, and has been a factor of huge significance in the breeding and subsequent reintroduction of this IUCN-rated Critically Endangered frog to the wild.

There are a plethora of reasons why amphibians make great pets, but one





The last of his kind. Toughie is the only living example of Rabb's fringe-limbed tree frog. Photo courtesy Brian Gratwicke from DC, USA.

fascinating and often forgotten fact is that these animals can be trained! As an example, dart frogs at Disney's Animal Kingdom, Florida, have been trained to climb into containers upon command, making the task of taking their weights much easier, and less stressful for the frogs! With all these factors in mind, it's certainly worth looking into acquiring some amphibians for your collection...

Choose carefully

The diversity that exists within this group of creatures, however, means that it is always important to do some detailed research into your chosen species before starting out. Take the African bullfrog (*Pyxicephalus adspersus*). These frogs are sometimes sold under the name of "Pyxie frogs": a name that suggests a small, fairy-esque type of frog.

When you first see them, they may indeed be quite small – perhaps 2.5cm (1in) long, and with a cute rounded shape. However, Pixie frogs can rapidly grow into huge individuals weighing over 2kg (4.5lb), and with an appetite to match their size! A frog of these proportions may quickly outgrow its accommodation, so make sure that you've read up about the species that you are interested in acquiring, not to mention its specific requirements....

Materials

This list suggests materials you'll need for setting up a new amphibian enclosure. Of course, there are likely to be more complex items such as waterfalls that can be used or may be required, so this should only be taken as a basic list for a starter setup:

- Vivarium
- Spray can (for misting)
- Pond/water bowl
- Substrate such as vermiculite or moss
- Plants – real or artificial
- Hides and rocks
- Calcium supplement
- Thermometer(s) to check the temperature
- Hygrometer(s) to measure humidity
- A means of warming the enclosure (as necessary)
- Live food
- Husbandry manual for the species
- The amphibians themselves!

The enclosure: Amphibian enclosures range from totally aquatic setups to terrestrial environments. There is no one single environment that suits all types.

Some species, such as dart frogs and mantellas, offer an opportunity to set up a planted enclosure. Plants such as bromeliads can enrich the animal's environment and potentially encourage breeding and natural rearing behaviours. Some dart frogs use the pools formed inside bromeliads as tiny rearing chambers for tadpoles: this behaviour could be used to great advantage in captivity! A well planted enclosure can be very aesthetically pleasing, while potentially recycling some of the amphibians' waste products.

If you are interested in producing a planted



▼ The Panamanian golden frog no longer survives in the wild.

vivarium, research into bulbs that encourage plant growth is critically important. Many companies now produce bulbs specifically for planted vivariums for this purpose: without these, the plant community will struggle to survive. Ensure

that you have chosen light of the right intensity, and try to match the plant's natural growing conditions.

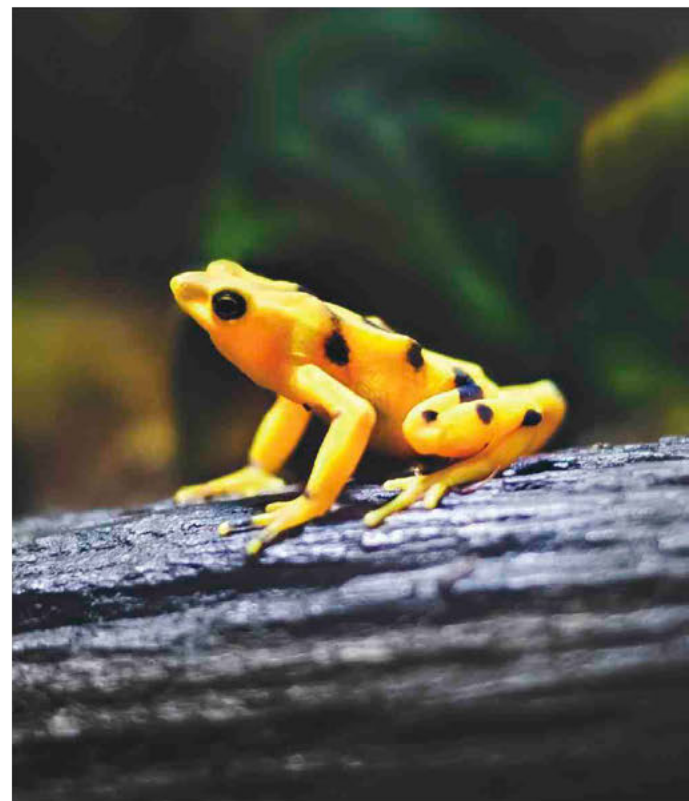
As an extreme example, a desert plant is unlikely to thrive in a tropical rainforest tank!

Also bear in mind that there are some species that will actively destroy a well-planted tank.

Horned frogs are large, round amphibians that spend the majority of their time submerged in their substrate, waiting for their next meal to pass within reach. Even small horned frogs can dislodge roots and upturn plants, making a planted terrarium difficult to maintain. Using potted plants will help to minimise this damage, as long as the pots do not impact upon the amount of space the frog has available to burrow in.

The axolotl (*Ambystoma mexicanum*) is an exclusively aquatic amphibian: for these animals, enclosure maintenance can be a little more complex. Techniques have

The African bullfrog grows to a massive size.





been borrowed from the fish-keeping hobby in order to address the needs of these amphibians: these techniques include using a beneficial bacterial culture to seed the filter and so assist the breakdown of harmful waste products such as ammonia, as well as pH testing.

Environmental factors

Temperature

Amphibians are described as poikilothermic: unlike a mammal or bird, these animals produce minimal amounts of body heat. Their temperature, therefore, tends to fluctuate with the environmental conditions. Furthermore, amphibians rarely thermoregulate in the same way as reptiles. A Horsfield's tortoise (*Agrionemys horsfieldii*) can elevate its temperature by basking in the sun, a process known as heliothermy. Similarly, the leopard gecko (*Eublepharis macularius*) can heat its body above the chilly night time desert temperatures by warming its body against sun-scorched rocks: this behaviour is called thigmothermy. Amphibians, with their moist skins, are at risk of dehydration however, if they try to sunbathe or rest on hot rocks.

One of the only occasions when frogs have been observed to sunbathe is in response to infection. Diseased frogs may raise their temperature by this means in an attempt to overcome the illness. Increasing their body temperature at this stage is likely to increase the efficiency of their immune system, helping them to combat the infection.

Heat lamps then, are not the ideal method for heating an amphibian enclosure. Heat mats may not always be the answer either, particularly for burrowing species that dig deeper in order to avoid hot conditions, if there is a heat mat below the tank. It may therefore need to be fixed in the side

➤ Axolotls have been popular with amphibian keepers for many years, proving interesting, easy to keep and long-lived.

▼ Mantellas thrive in planted enclosures. This is a beautiful mantella (*Mantella pulchra*).



A red-eyed tree frog. A planted enclosure is essential for frogs of this type, with warmth and humidity also being vital.



Did you know?

Interestingly, an axolotl's external gills can grow or shrink according to the levels of oxygen in their water. Lower concentrations of oxygen cause the gills to enlarge, as they need to work with higher efficiency.

of the enclosure, and as with all heating, it needs to be operated under thermostatic control.

Ideal temperature parameters are species-specific and should be based upon the animal's natural habitat.

Research where the animal is normally found, and what temperature range it normally experiences in the wild. Is there a cold season? Cold periods are an important part of the year for some species, and exposing these species to cooler temperatures for a period may help them to prepare for the breeding period. Horned frogs are a good example of this: they require a period of artificial "overwintering" in order to emerge in breeding condition.

Humidity

For a group of animals with a thin, permeable skin, getting humidity levels right is of key importance to their wellbeing. As with temperature, there is no "one size fits all" rule for the humidity requirements of these animals. Some

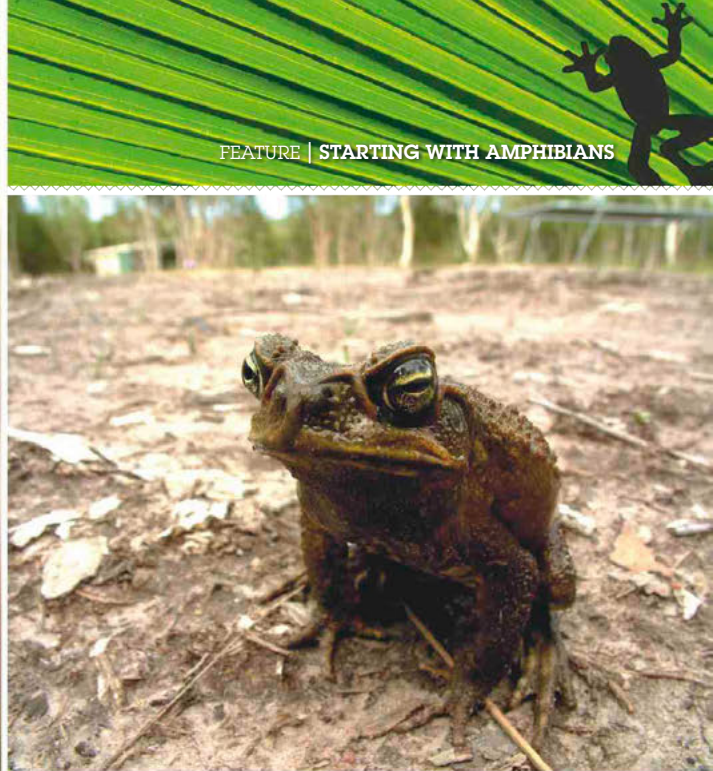
species, such as the cane toad (*Incilius marinus*) will tolerate relatively low humidity levels, whereas rainforest species including the red-eyed tree frog (*Agalychnis callidryas*) have much higher humidity requirements.

There are various ways of increasing humidity: the most obvious methods are spraying the enclosure each day, and including bodies of water in strategic places. In more complex set-ups, waterfalls and artificial rain systems have been incorporated: although initially more difficult to set up, these can be hugely beneficial for certain species.

Bear in mind that high humidity in an enclosure may also predispose to a build-up in both bacteria and especially fungal organisms: the damper the area, the more likely that cage furnishings such as leaf litter and logs will become rotten. Put simply, a tropical enclosure will require greater maintenance in order to prevent the accumulation of mould.

Ventilation

This is a vital aspect of husbandry that is sometimes overlooked. Ventilation helps to keep air fresh in the enclosure, serving to lower the potentially harmful microbial build-up in the tank. Most vivariums on the market are equipped with sources of ventilation. However, if you're redesigning a glass aquarium to accommodate your frogs or salamanders, make sure adequate ventilation is included.



▲ Cane toads can survive in quite arid surroundings.

iodine, which is the reason as to why these giant tadpoles never transform into salamanders.

Conclusion

Amphibians are quirky, often underrated animals that make an excellent addition to any collection, particularly as they do not require massive enclosures. There's an opportunity here to keep animals in conditions similar to their natural habitats, to widen our depth of knowledge on amphibians, and potentially to breed them, increasing their numbers to provide a backup for the threatened wild populations.

Simple amphibian enclosures are surprisingly easy to set up and maintain, while planted enclosures become progressively more scenic each year. It's not difficult to see why so many keepers are already focussing on these amazing animals, and there is always more to learn in the hobby of amphibian keeping, which adds to its appeal. ❖

Feeding

All adult amphibians (with the exception of just one species) are carnivorous. Furthermore, most species will accept only live food. They are conditioned generally to respond to movement, which alerts them to potential prey, activating their feeding response.

There is now a wide range of commercially available live food for amphibians: the smallest frogs hunt fruit flies (*Drosophila melanogaster*) whereas locusts (*Schistocerca gregaria*) make wholesome prey for the larger species. As with reptiles though, variety is key. There is no single live food that meets all the nutritional requirements for amphibians, so a varied diet will help to make up for shortcomings in particular food items.

Supplementation is also necessary. The calcium to phosphorus ratio of food is important in amphibians: it is generally suggested that the ideal diet should be two parts of calcium for every one part of phosphorus, giving a 2:1 ratio. Unfortunately, most invertebrate species contain much higher levels of phosphorus than calcium, although calci-worms come close to providing an ideal ratio.

Dusting live foods with products such as Vetark's Nutrobal™ and calcium powder should help to skew the balance in favour of calcium. As always, the frequency of supplementation required depends on the amphibian's lifestage: growing animals often need higher calcium

supplementation in order to support developing bones. Read the instructions for use carefully.

As juveniles, however, most amphibian species are at least partially herbivorous. There are specific formulated diets available for this critical stage of amphibian life. In the case of axolotls, it is very important to use just axolotl pellets for them. These have been carefully formulated to contain a low level of



Be sure to match the food you offer to the amphibian's size and lifestyle. Tree frogs are not inclined to feed on the ground.

A young razor-backed musk (*Sternotherus carinatus*) turtle. This species is a good choice as a pet.



Talking turtles

Back in the late 1980s through into the early 1990s, when the popularity of the *Teenage Mutant Ninja Turtles* was at its peak, people rushed to buy pet turtles, without giving adequate thought to their care. Many of these reptiles died as a result of ignorance, but some survived, as David Alderton explains.

The lasting legacy of that period can still be glimpsed in various stretches of water around the country even today, where discarded turtles are still to be seen. Those who had taken on cute little hatchling red-eared turtles (*Trachemys scripta elegans*) often watched in horror as their pets continued growing, to the point that they could potentially reach the size of a dinner plate. No longer able to accommodate these turtles by this stage, and with rescue shelters overflowing, so a number of owners decided simply to discard their unwanted pets into ponds and other stretches of water around the country, as their novelty had worn off.

Myth and reality

It is virtually impossible to get any accurate figures for the numbers of such turtles that were abandoned illegally in this way, and there were apparently no prosecutions either. But these events have created a lasting urban myth, of turtles lurking unseen in waterways nationwide, dragging down helpless ducklings to their deaths.

This popular mythology conveniently overlooks the fact that adult red-ears actually become much more vegetarian in

their feeding habits, as they grow older. Furthermore, in their North American homeland, they are not noted as killers of young water birds, and it is much more likely that pike swimming below the surface are responsible. But that would, of course, spoil the popular media stories that still surface regularly around these turtles!

A new problem?

People in the trade have therefore been very concerned that the launch of a new *Ninja Turtles* film this autumn could trigger a similar increase in demand, and have

taken steps to prevent this type of problem arising. You may have seen posters produced for this purpose in your local reptile store, urging would-be turtle owners to think very carefully before taking on a pet of this type.

Healthy living

Nowadays, as in all aspects of reptile care, things have moved on significantly in terms of caring for turtles. Whereas specially formulated food for them was hard to obtain during the 1980s, there is a much wider range of products of this type

▼ A hatchling red-eared turtle.



Red-eared turtles grow to a large size, and can be seen basking on sunny days, out of the water.



now available, catering for turtles of all ages.

This has played a major part in eliminating nutritional disorders such as hypovitaminosis A, resulting from a diet comprised of raw meat which is deficient in vitamin A, and so-called soft shell, which could be the result of both a shortfall of calcium and vitamin D3. Effective lighting now allows turtles to bask and benefit from the UVB rays, so they can manufacture vitamin D in their bodies naturally in this way.

The use of prepared foods also brings another, less evident benefit. Turtles can be a source of *Salmonella* bacteria, which may be acquired from their food. Since they are now no longer fed on raw meat, the risk of them acquiring this particular infection, and passing it on to you is reduced. As with all reptiles though, and pets in general, it is important to take sensible precautions if you keep turtles.

Always wear gloves when handling them, or servicing their quarters. Especially given their popular image through the Ninja Turtles films, it also needs to be emphasised that they do not make good pets for children. Turtles can become tame, but they do not like close interactions with people.

Furthermore, their shell can become badly damaged if they are dropped through careless handling. In fact, extra care needs to be taken when handling turtles, because their shells are slippery, and they may struggle, kicking out with their hind limbs especially, which are equipped with sharp claws. The safest way to pick up a small to medium-size turtle is to put your finger and thumb across the shell, gripping it here where your fingers should be out of reach of its legs.

Making the right choice

A highly significant trend in turtle care over recent years has been that today, you will generally not be presented with potential tank-busters, in the guise of sliders and cooters.

Wholesalers, turtle breeders and the trade generally are now much more focused on species that will only attain a small size when adult.

The two species that you are most likely to encounter today are the musk turtles and Reeves' turtle (*Mauremys reevesi*), both of which only attain a length of about 15cm (6in) long. Another relatively small species is the Chinese golden-thread turtle (*Ocadia sinensis*), which grows to about 20cm (8in) overall.

Although young turtles are compatible at a young age, it is usually not a good idea to purchase more than one. They are not social animals, and what can easily happen is that a male will start to persecute a female as they mature.

Within the relatively restricted confines of a tank, she may not be able to escape his persistent courtship. This can affect her ability to eat, and before long, it will impact on her health, with any injuries likely to become infected by fungus.

Turtles can be sexed in a similar way to tortoises as they mature, with the underparts of males being concave. The ano-genital opening is located further down the tail, which assists mating.

Most turtles should be held by the sides of their shell, as seen here.



Housing

Although an adapted aquarium may seem the obvious starting point for a turtle set-up, bear in mind that glass tanks are heavy, not to mention slippery when wet. There can also be a further problem with the way that they are constructed, if the turtle's claws damage the silicone sealant holding the sheets of glass together. This could result in a potential leak.

Especially for young turtles therefore, a moulded acrylic tank is a better option. Make sure there is a suitable basking light over the dry area, to which they need easy access. Aside from the vitamin D benefits, basking also helps to protect turtles against fungus.

▼ Turtle sticks, formulated to meet the nutritional needs of these reptiles, have led to a dramatic fall in cases of nutritional illness in these reptiles. They generally prefer to eat in water rather than on land.





There is now no need to rely on a traditional glass heater-stat to maintain the water temperature in the tank. One of the polymer heater-stats now available will be a better choice, as these units are much more robust, and are unlikely to be damaged, even by larger individuals. The water temperature itself will need to be kept around 25°C (77°F) for young turtles, although it can be slightly lower for adults.

Furthermore, these polymer heater-stats may be shorter in length than a conventional glass tube, making them more suitable for a turtle tank, where the water level will be lower than in an aquarium. Musk turtles in particular do not require a large depth of water in their tank, often being described as bottom-walkers.

They prefer to move in this way, rather than actively swimming, apart from coming up to the surface to breathe.

There is little point putting plants in a set-up housing a turtle, because those in the substrate are likely to be uprooted. Many turtles will also nibble plants as well.

In order to keep the tank clean, a power filter will be essential. Avoid overfeeding turtles. Follow the same routine as for fish – a little and often, to minimise any wastage, as this will otherwise have a harmful impact on water quality.

Young turtles should be fed daily, being offered food in two or three small meals. You will soon come to recognise how much food your turtle will require. Older individuals can be fed 4-5 times a week. ❖

▲ A Reeves' turtle. Its size makes it relatively easy to accommodate in the home.

A fairly bare tank with rockwork will be required. Make sure gravel is sufficiently coarse so that it cannot be swallowed. Otherwise, it may cause a potentially fatal impaction in the intestinal tract. With bigger turtles, pebbles could be safer as a floor covering.



New for turtles from Exo Terra



The Exo Terra Turtle Clear Aquatic Habitat Cleaning Kit is a set of maintenance tools that makes cleaning a turtle's quarters more straightforward. This easy-to-use kit includes a gravel cleaner, plus a 2-in-1 algal removal tool. It is a combination scraper blade and pivoting scrubbing pad on a 40cm (16in) reinforced plastic handle.

The durable, non-toxic, scrubbing pad easily removes unsightly algae and sludge, from rocks as well as the sides of the tank. The plastic scraping blade can be used for stubborn algal and mineral deposits, which can be a particular problem in hard water areas.

The pivoting scrubber head provides better control, increased pad-to-surface contact, and easy access to hard-to-reach areas. This tool should only be used on the sides of a glass tank, however, as it can scratch acrylic.

The Exo Terra Gravel Cleaner is a convenient tool designed for routine water changes and maintaining ideal water quality. Aquatic turtles can be messy eaters, resulting in uneaten food and waste accumulating in the gravel bed and under items of tank décor, such as rockwork.

Excessive waste produces high levels of ammonia, phosphates and nitrates that can affect water quality, predisposing to algal growth. Any accumulation of dirt in the tank is also likely to result in an unpleasant odour.

The cleaner has a 45cm (18in) cleaning tube, with a non-kinking hose reaching 1.5m (5ft) long. It is also equipped with a gravel guard, to prevent this substrate from being sucked up and passing into the maintenance bucket.



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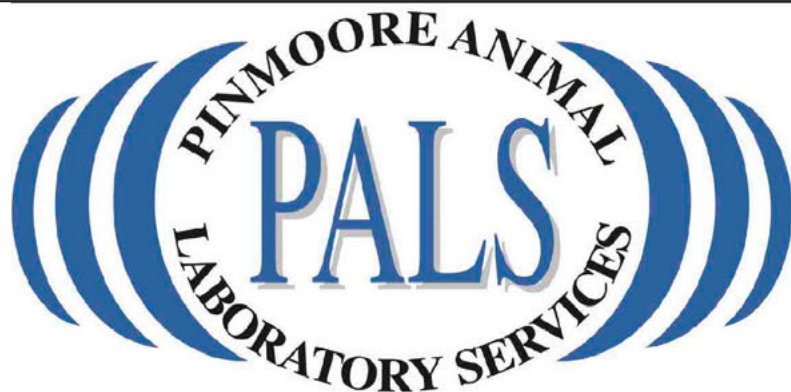


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See our new website page dedicated to owners & the special section for reptile owners

QUESTIONS & ANSWERS



DO YOU NEED A HELPING HAND OR ADVICE?

Email your queries to prk.ed@kelsey.co.uk or write to the address on page 66. A selection of submitted questions will appear here every month, and a prize of Vetark products will be awarded to the writer of the Star Question. Regrettably, replies can only be given through this column, and if you are worried about the health of your animal, seek veterinary advice without delay.



Photograph courtesy L. A. Dawson.

Caring for flying geckos



I have a pair of captive-bred flying geckos. I know that this is a crepuscular species that becomes active at dusk, but how do I provide

lighting in the enclosure so that I can see in and offer the correct amount of UV energy without upsetting their night-time activity? Any other care tips please?

The so-called flying gecko (*Ptychozoon kuhli*) is an incredible species of arboreal lizard found over much of south-eastern Asia. Those that are imported come from Indonesia, and are often badly affected by intestinal parasites. They will therefore need screening and treating if necessary, with suitable medication. Having said that, I am delighted to say that just as in the case of your pair, many of these lizards are now being captive bred.

This is an incredible species to watch and to

breed, and flying geckos will reproduce without too much bother when their vivarium conditions are right. It can then become quite easy. In fact, many keepers allow in-situ incubation here, simply by placing a deli-cup containing damp moss over the two eggs which make up the clutch.

The flying gecko is essentially an insect-eating species but in the wild, they will take pretty much anything that they can fit in their mouths. They are agile and very fast, and possess the incredible ability to stretch forward and open their ribs to reveal a parachute of skin folds that enable them to glide away safely from danger.

Nevertheless, a flying gecko will not normally react in this way in a vivarium, as this is primarily a defence against predators. In common with better-known geckos such as tokays and crested, they have the ability to "stick" to glass with the aid of the fine hairs of the toes. This means they can prove adept escape artists, if their enclosure is not covered with a tight-fitting lid.

Lifestyle and environment

As with all aspects of captive care, the answer to your question is hidden in the wild. If we look at the parameters of the home range of any species, so we will start to build up a picture of care that it requires. The flying gecko is no different.

So what does their native environment tell us? They are found in very humid montane rainforest surroundings. An average daily temperature of 27°C (80°F) all year long is commonplace, with rainfall everyday maintaining the humidity in a band between 60-80%, depending on the location.

The available ultraviolet index (UVI) above the emergent is around 7-9, depending on the time of year. This massive energy is reduced though, as light and energy from the light travel through the cloud, and enter the rainforest, passing through the canopy and down into the understory. Flying geckos themselves inhabit the area between the understory and canopy, moving between these levels.



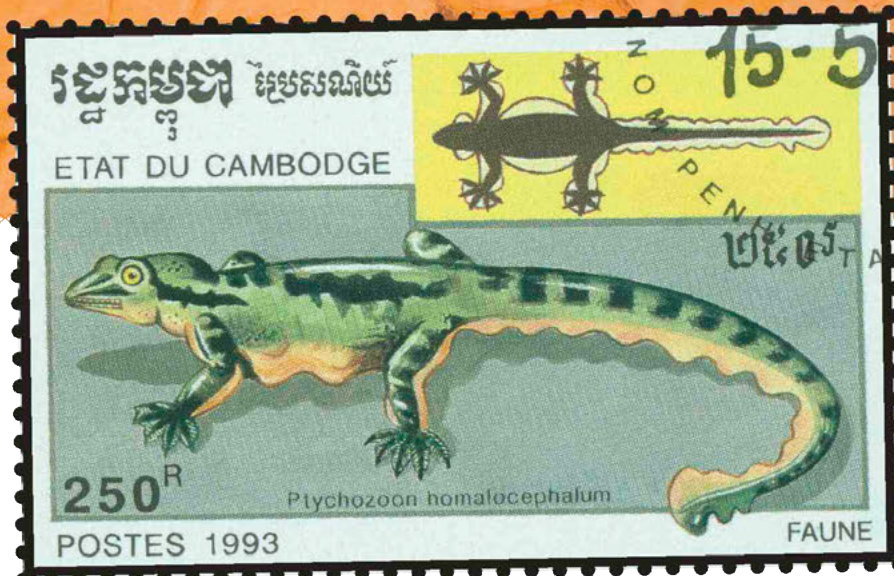
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Another member of this group.

We can see from the shape of the eyes of these geckos, with their slit-shaped pupils, that they have developed to live under conditions where the level of light is relatively low. They clearly become much more active in terms of feeding and moving around when it is darker and potentially safer in the forest.

We can also see that they have a very thin skin, like most crepuscular species. This allows them to regulate their heat and light exposure very quickly

indeed. In reality, this gecko is totally adapted to life as a predator, which can be found stalking the forest at dusk and through the night.

So do flying geckos need UVB lighting? Well, the answer has to be yes. UVB can be measured in quite high quantities even when conditions are nearly dark, and also, we know that in the wild, this species has amazing camouflage that allows it to sleep in the canopy by day. It disguises its presence here simply by laying flat against a branch in relative safety. It is important to bear in mind that you do not need to be awake to benefit in full from the Vitamin D3 cycle. As a result, these geckos will benefit if provided with a measured, safe allowance of UVB energy in vivarium surroundings.

Given the location in which they are to be found in the wild, bright light is certainly not required. Instead, a dappled recreation of sunlight should be the aim. Providing this is very simple indeed. All you have to do is to use a lamp that produces a target index at a certain distance and that this illuminated area is balanced with other shaded areas.

The geckos can then choose when and where they are exposed to the light. This approach not only mimics the situation in the wild very effectively, but also means that you can be certain that any given species can assimilate and use the level of energy that it requires, rather than what we may (perhaps mistakenly) decide it may need.

In this instance, with your enclosure being 1.2m (4ft) high and 0.9m (3ft) wide, I would use a D3+UVFLOOD fitting, positioned as far as possible

into the 'hot' side of the enclosure. This will light about a third of the vivarium with UVB-rich light. Please remember that UVB decreases considerably in power the further away that light has to travel from the lamp. This product is therefore not too strong for this species if you use decoration properly.

the shape of the eyes of these geckos, with their slit-shaped pupils, that they have developed to live under conditions where the level of light is relatively low.

Care needs

You will need to place a vertical branch under the unit, with plenty of branches and leaves coming off it. This will generate vertical shade as well. This branch must not be any higher than 38cm (15in) from the lamp to the animal at the highest point. Then decorate the rest of the enclosure to mimic a rainforest. You can use live ferns and orchids, with Asia being home to a myriad of such plants.

Aim to virtually overplant the enclosure, so that the animals have plenty of space to self-regulate and to lay their eggs. You can then use a plug-in timer so that the UV system comes on for defined times during the day. Being able to see UV light (unlike ourselves), so the geckos will be able to get into this pattern and will shift their location accordingly as required.

I would suggest having the light on from 7am until 11am, then switched off until 4pm when it can come back on through the early evening, up to about 7pm. The geckos may only expose themselves directly for a few minutes a day, but if that is all that they need, you as a keeper have done your job. I would aim for an index at the top of the "basking spot" of around 2-3 and decreasing from there.

In terms of live planting, you can use a supplementary lamp in the form of a single 13w Jungle Dawn. This will provide all of the energy from light (PAR) that the plants need to thrive. It will complement the UVB system and can then also be the sole source of visible light for those times of the day when this light source is off.

A bioactive enclosure with living plants and

beneficial tiny creatures such as springtails is definitely to be recommended. The bacterial load will be kept to a minimum and humidity levels can be maintained at a higher level more easily.

Provide the heat that is required using a thermostatically controlled system. You can choose light-emitting heat lamps or ceramics, if these are suitably protected to prevent any risk of these climbing geckos coming into direct contact with the heat source, and burning themselves.

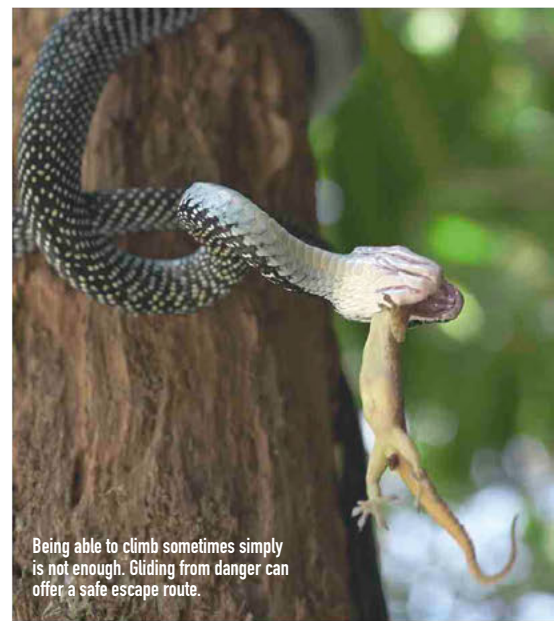
A misting unit can be used or a hand sprayer can be used to maintain the required humidity level in the vivarium, but ensure water droplets do not fall on the heating system or any other electrics. High humidity is needed, but it is also vital to have good ventilation because otherwise, fungal growth is likely to become an issue. A simple "push, pull" computer fan system used once or twice a day should help to ensure adequate ventilation in the vivarium.

Then think about diet. I would provide a very varied offering of gut-loaded crickets, silkworms, calciworms, Dubia roaches of suitable size and other items. Some of these geckos may even feed on the contents of fresh, broken quail

eggs. A good full spectrum supplement such as Nutrobal will need to be used as instructed, but bear in mind if you are providing UVB to the wild level, then synthetic D3 is almost not required.

I wish you every success with this species. I hope your pair breed successfully and I look forward to seeing many more captive-bred flying geckos becoming available in the future.

*John Courteney-Smith,
Reptile Product Manager, Arcadia.*



Being able to climb sometimes simply is not enough. Gliding from danger can offer a safe escape route.

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New amphibian breeding mode discovered

Researchers from the National University of Singapore (NUS) have discovered a new reproductive mode to add to those already recorded in frogs and toads. The white spotted bush frog (*Raorchestes chalazodes*) both breeds and lays its eggs directly in live bamboo, gaining access through narrow openings. This critically endangered frog is currently one of only two species known to display this reproductive method.

Life history strategies to increase reproductive success are described as 'reproductive modes'. Frogs and toads currently exhibit 40 known reproductive modes, including 17 aquatic modes and 23 terrestrial modes. This new research reveals the discovery of the 41st reproductive mode, representing a unique addition to the list.

Even more amazingly, the species of frog exhibiting this behaviour was thought to have been extinct for over 100 years, until it was found again recently in the wet evergreen forests of the Kalakad Mundanthurai Tiger Reserve in the Western Ghats.

The role of bamboo

Mr Seshadri K S, a PhD student, and Assistant Professor David Bickford from the Department of Biological Sciences at the NUS Faculty of Science, discovered the amazing reproductive strategy of this species. Adult male frogs enter hollow internodes of the flute bamboo (*Ochlandra travancorica*), where they vocalise to attract mates. They make their way into the bamboo through a small opening, possibly made by insects.

Female frogs are attracted to the calls and follow suit, laying about 5 to 8 eggs inside the bamboo. Other females may also choose to mate with the male frog and deposit their egg clutches in the bamboo

Scientists have just reported a new type of reproductive mode, observed in a critically endangered frog found in south India's Western Ghats area.

as well. The male stays in the bamboo to take care of the eggs, which develop directly into froglets, with no tadpole stage in the lifecycle.

Although the adult frog is small, under 2.5cm (1in) in length, it enters the bamboo with considerable difficulty because the available openings are often less than 5-10mm (0.2-0.4in) in length and just 3-4mm (0.11-0.15in) wide. The researchers observed that these frogs only breed in bamboo with openings at the base of the internode. Those with openings at the top would allow for collection of water, which could flood the eggs or drown the froglets.

The adult males actively search for suitable openings in bamboo and possibly defend territories. They leave the bamboo for a few hours in the evening to feed and then return to look after the eggs.

Another member of the research team, Dr Gururaja K V from the Centre for Infrastructure, Sustainable Transportation and Urban Planning at the Institute of Science, Bangalore, India, discovered that another species of frog, known as the

The white spotted bush frog breeds in a way not previously recorded.
Photo courtesy Seshadri K.S.

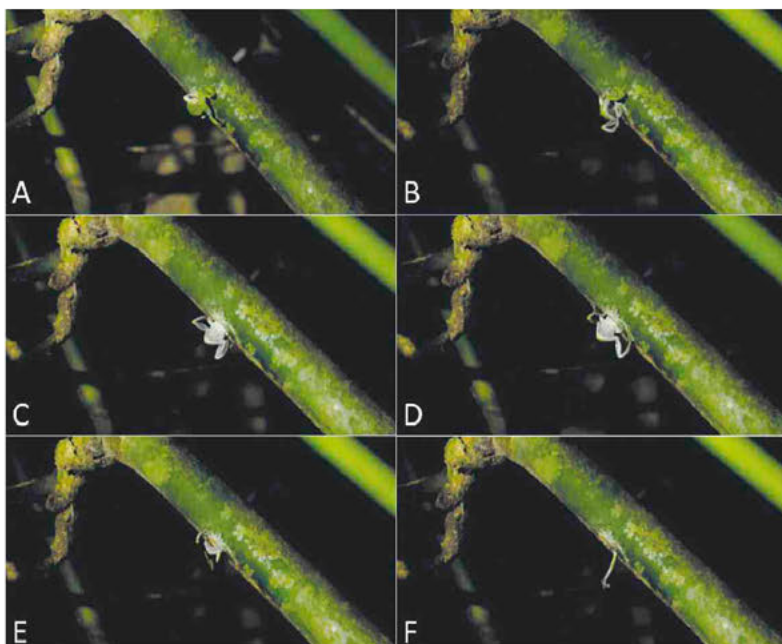
Ochlandra reed frog (*Raorchestes ochlandrae*), also breeds in internodes of bamboo. While the geographic ranges of these two species do not overlap and nesting occurs inside different species of bamboo, their reproductive mode is comparable.

Aiding their conservation

The white spotted bush frog itself is critically endangered, with small populations occurring in fewer than five known localities. As this species only breeds in bamboo, unregulated overharvesting of bamboo for paper and pulp may destroy breeding habitats, having a negative impact on the long-term viability of the populations. It is critical to conduct more studies on these unique frogs, with the aim of developing frog-friendly bamboo harvesting techniques in order to conserve them.

Mr Seshadri says: "There are also several evolutionary questions that could be answered by further study of this fascinating group of frogs. For example, what transpires inside the bamboo internodes is still a mystery. The Western Ghats is a well-known hotspot for amphibian diversity, but is currently under threat, largely from habitat loss. If we do not initiate conservation efforts now, we may lose everything before it can be documented." ❖

◀ **Adult male white spotted bush frogs enter hollow internodes of the flute bamboo where they vocalise to attract mates. Gaining access here is difficult for them.**



Further Information

Kadaba Shamanna Seshadri, Kotambylu Vasudeva Gururaja, David Patrick Bickford. **Breeding in bamboo: a novel anuran reproductive strategy discovered in Rhacophorid frogs of the Western Ghats, India.** *Biological Journal of the Linnean Society*, 2014; DOI: 10.1111/bj.12388

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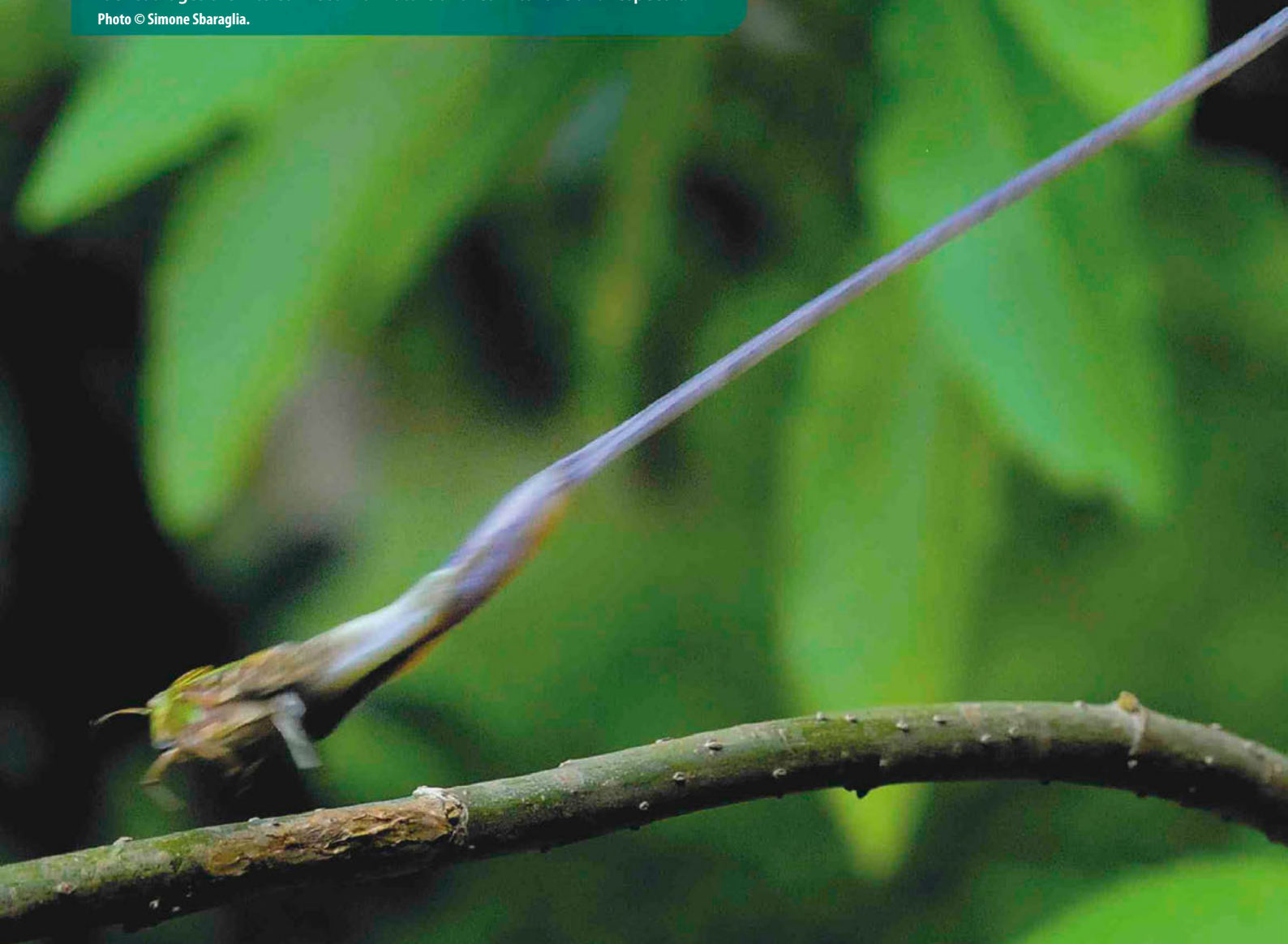
Panther chameleon (*Furcifer pardalis*)

This remarkable photograph of a panther chameleon with its tongue fully extended, seizing a bug, has recently been awarded the Zoological Society of London (ZSL) Animal Photography Prize 2014. It was selected from thousands of entries by a panel of judges, including ZSL Honorary Conservation Fellow and television presenter Kate Humble, as well as ornithologist Bill Oddie.

The photo also won the Perfect Moment category, and can be currently seen as part of an exhibition of winning photos at the zoo. To plan a visit, go to <http://www.zsl.org/>

Winning photographer Simone Sbaraglia explained: "I spent a significant amount of time trying to learn the lizard's behaviour, attempting to anticipate the moment. After several days, I was able to achieve the picture that I was looking for. I hope that when people see it, they are amazed by this animal and it encourages them to connect with nature and learn to love and respect it."

Photo © Simone Sbaraglia.





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Did you know?

A chameleon can expel its tongue at a speed equivalent to nearly 22kph (13.4mph). The rate of acceleration involved is such that it exceeds what can be achieved by muscular contraction alone. Scientists have now identified a catapult-type mechanism, in the form of elastic collagen tissue linking the bone in the tongue directly with the accelerator muscle that propels the tongue out of the chameleon's mouth, explaining how this is achieved.

JOANNA'S CASEBOOK

The way in which our understanding of illness in reptiles has advanced has been paralleled by a rapid expansion in the diagnostic techniques that are now available to vets. In her column this month, specialist veterinary surgeon Joanna Hedley explains some of the newer diagnostic tools now being used in this area, and how these compare with more traditional tests.



New diagnostic techniques

As reptiles continue to grow in popularity as pets, and with more species now being bred, so there is an increasing demand for veterinary services in the field of herpetological medicine. It is not just a case of new treatments either, but being able to establish what is wrong with patients in the first instance, as quickly and efficiently as possible, that can play a major part in terms of ensuring their recovery.

Consequently, a wide variety of diagnostic techniques are now available to assist vets in this field, often having been adapted from those used in human medicine. But while a number of tests may be considered for a sick reptile patient, what benefits do all these new diagnostics really bring?

Imaging

Imaging is often one of the first steps normally taken when seeking to obtain a diagnosis for a sick reptile, and in most cases in the past, this has historically involved taking radiographs (better-known simply as X-rays). Over recent years though, digital radiography has become widespread, and these images can now be viewed almost immediately and stored on a computer, to refer back to at a later date.

Digital images can also be magnified and adjusted to aid visualisation – a distinct advantage over those on traditional X-ray film,

especially in cases involving smaller reptile patients. The majority of chelonians and lizards can be X-rayed without sedation, and the resulting images can quickly reveal abnormalities in bones, foreign bodies, eggs or even bladder stones.

However, X-rays are not ideal for evaluating changes in soft tissue, especially in chelonian species where the shell is superimposed over most of the internal organs. In these cases, ultrasound can be of more use to identify abnormalities within soft tissue structures.

Size can, however, be a restricting factor with many traditional dog and cat ultrasound machines, as these are not able to provide sufficiently clear images of smaller patients. Higher resolution units are now available though, and they

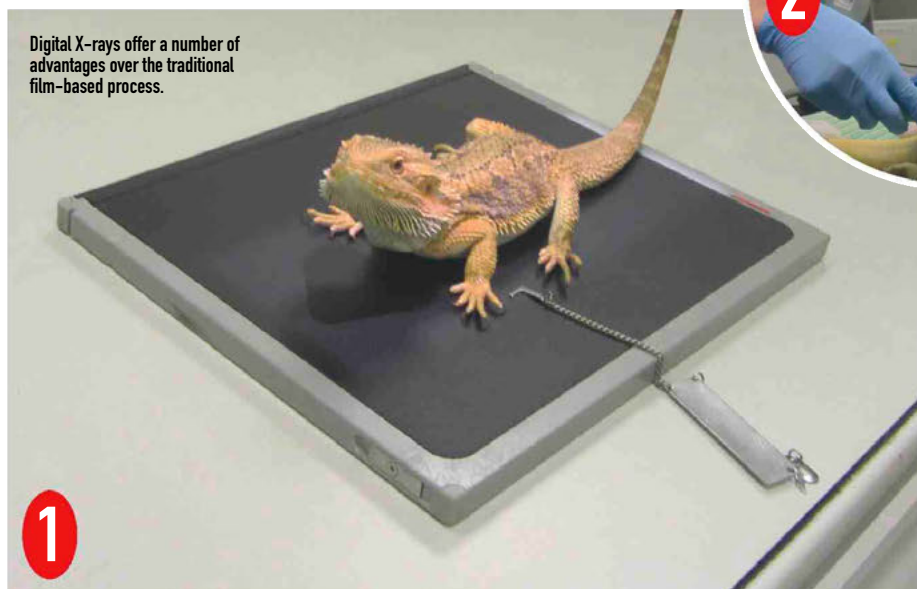
are increasingly likely to transform our ability to visualise soft tissue. Some are even able to detect changes in structures as small as a gecko's ovary, although units of this type are not in widespread use as yet, outside specialist centres.

Advanced imaging

Other diagnostic options in this field that are becoming increasingly popular are advanced imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI). CT works on the same principle as taking an X-ray but is rapidly able to produce a series of sections through an animal that can then



Ultrasound is now a widely-used diagnostic technique with reptiles.



Digital X-rays offer a number of advantages over the traditional film-based process.

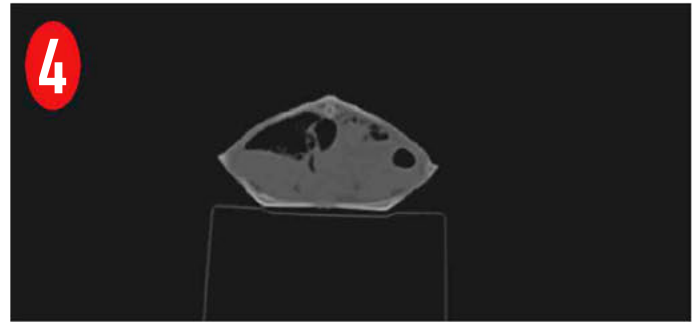
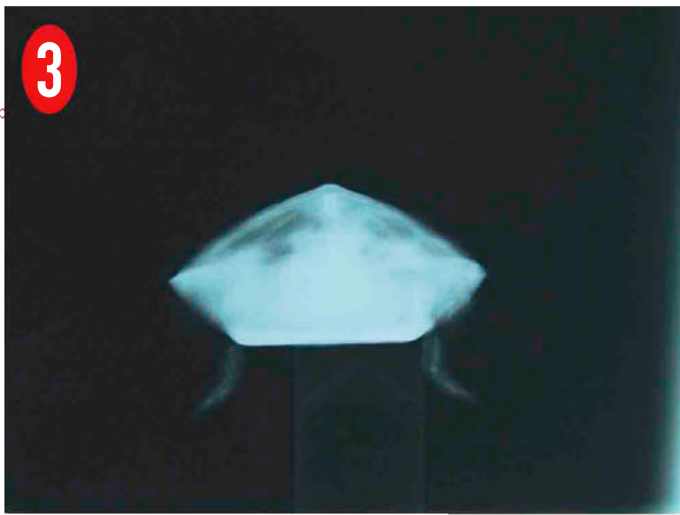


Figure 3&4 An X-ray image set alongside a CT scan, which provides a series of images, affording clearer insight in to the problem and its precise location.

be reconstructed to create a 3D image. This has the distinct advantage of avoiding superimposition of structures and provides much more detail, as can be seen when an X-ray image is directly compared with a CT scan.

In the case of a snake, a CT scan can even be carried out while it is curled up in a box and images can then be reconstructed on the computer to "straighten out the snake" for evaluation purposes! This contrasts with the situation with X-rays where snakes either need to be restrained in a tube or anaesthetised in order to obtain images that will be of diagnostic value.

MRI scans in comparison are best for assessing soft tissue structures, the spinal cord and brain. This is, however, a much longer procedure and normally requires a general anaesthetic so that the patient remains still and multiple images can be taken.

The costs for both CT and MRI procedures are greater than for X-rays, because of the very high cost of this type of equipment, and the expertise required to interpret the images. Nevertheless, prices are slowly reducing though, as the technology becomes more widely available, and veterinary insurance can cover the expense of these diagnostic methods, as part of an individual's treatment.



Specific viral tests can now be used for arenaviruses in boids, helping to identify potential cases of IBD.

Endoscopy

Endoscopy is technically just another form of imaging, using a small camera to look directly inside the patient. This may be into the mouth, the vent or even into the body cavity and lungs under general anaesthesia.

Visualisation of the internal organs allows a veterinary surgery to evaluate them, take samples and even perform keyhole surgery if necessary. Costs for this have again traditionally been high due to the price of the equipment, and the specialist training required to perform endoscopy, but again, these are falling now, as this technique is now being much more commonly used in veterinary medicine.

The diagnosis of Infectious disease

As an increasing number of specific infectious diseases are identified in reptiles, more tests are becoming available to screen for these conditions, often involving so-called molecular techniques. This field is developing rapidly at present.

Over the last few years, new tests for significant diseases such as paramyxovirus (PMV) and arenaviruses (recently found to be associated with inclusion body disease/IBD which is a significant illness in boids) have become available, marking a very significant breakthrough in the field of reptile medicine.

Final thoughts

Many of these tests just need a swab from the mouth or vent that can easily be obtained. However, although some of these tests are highly specific, no test is 100% reliable for detecting

disease. A test result therefore needs to be interpreted in combination with the whole clinical picture. If an unexpected positive or negative result is received, the question that has to be answered is whether this is really a true result, or a problem with the testing?

The advances in diagnostics for reptiles are exciting, but rarely replace the need for some of the more basic, relatively inexpensive tests. Faecal or blood samples can often be easily obtained and may provide a good starting point, when it comes to establishing a reptile's general health status. They also act as a way of directing the focus for further investigations.

Finally, none of the advanced diagnostics in the world will replace the simple checks that you can do at home. Observing the basics such as the environmental temperature, humidity and UV lighting is often the key starting point for diagnosis in many cases! ❖



Endoscopy give a very clear image of what is happening within the body, and can also be invaluable in terms of carrying out surgery that may be required, without the need for further anaesthetic.

Joanna Hedley, BVM&S, DZooMed (Reptilian), DipECZM (Herpetology), MRCVS has had a varied clinical background since graduation. Her work has included developing a first opinion and referral service for exotic pets in clinical practice and involvement in a number of wildlife charities both in the UK and abroad. She completed a residency in Exotic Animal and Wildlife Medicine at the Royal (Dick) School of Veterinary Studies in 2011 and worked there as a Rabbit, Exotic Animal and Wildlife Clinician, before recently moving to take up a new post at the Royal Veterinary College. Jo holds a RCVS Diploma in Zoological Medicine (Reptilian).



GETTING TO GRIPS WITH garters

For many years, garter snakes have been dismissed rather as beginner's choices, especially given the increasing number of other species now featuring in the hobby. However, as Phil Purser, Ph.D. explains, garter snakes offer something for everyone, whether you are a novice or a more experienced keeper.

One of the first garter snakes I ever encountered in the wild was a common garter snake (*Thamnophis sirtalis*). This wily serpent was lying quietly coiled under a log in a small triangle of forest near the garden of my childhood home. While dad was planting tomatoes and corn, I was stealing away from the toil to search for crawling things, and a small black and yellow-striped serpent, measuring roughly 50cm (20in), was the fruit of my labours on that particular day.

Seizing up the small snake, I quickly discovered that, unlike the relatively mild-mannered kingsnakes (*Lampropeltis* species) that I was used to catching, this snake resisted capture in a number of ways. It twisted and thrashed around although I was careful to cradle it gently to prevent it from injuring itself in its attempts to flee. The snake then emptied its cloacal contents on me, as a further deterrent to being restrained, it bit

► Phil encountered the garter snake in a woodland area. Its reaction was very different, compared with the kingsnakes with which he was familiar.





repeatedly, and also exuded a thick, foul-smelling musk.

While it calmed down and quickly adapted to vivarium life during the time I kept it in my bedroom, its initial defensive display far exceeded what I had seen in other, larger colubrids. Garter snakes seem a contradictory species: while many people regard these snakes as being only of interest to younger or very inexperienced hobbyists, nothing could be further from the truth. Just as that snake's defences were complex and sudden, many other life aspects of the genus *Thamnophis* can be complex,

▲ There is also considerable variation in the appearance of members of the same species.

▼ The San Francisco garter snake (*T. sirtalis tetrataenia*) is a rare and colourful subspecies, restricted to a localised area close to the city.

multi-layered, and may often become manifest in vivarium surroundings.

While younger hobbyists can certainly enjoy a pet garter snake, these serpents are most definitely not the simple, one-dimensional snake that they have long been considered by some in the hobby. They provide a great deal of scope for the specialist and those interested in serpentine behaviour. In fact, these snakes, above many other colubrids that I have worked with through the years, exhibit a wide range of purely natural behaviours even in the confines of a vivarium.





That is to say that while many snakes will become “conditioned” to a feeding schedule and simply take a pre-killed mouse from the feeding tongs, many garter snakes will still actively “hunt” their prey in vivarium surroundings. Watching a large-eyed garter snake rising up, spotting a worm, moving stealthily at first, then rushing forward with lightning speed, only to seize its prey in its jaws, chew and grind its quarry to death, and slither away with its meal is truly impressive. It brings you closer to nature.

Of course, there is a wide range of diversity when it comes to owning a pet garter snake. From the common garter that I found along the edge of the garden patch at my childhood home, through the cobalt beauty of the blue garter snake, to the infinitely sought-after red flecks and bold stripes of the San Francisco garter snake, the genus *Thamnophis* truly has something for colubrid hobbyists of all levels of experience. And with their semi-arboreal cousins, the ribbon snakes, added into the equation, the diversity of the genus *Thamnophis* becomes all the more evident. So let’s explore the natural history, diversity, and care requirements of these impressive, complex, and often underrated serpents.

Natural history and biology

The genus *Thamnophis* is comprised of around 30 species and many more sub-species, representing the most wide-ranging colubrid group in the world. A representative of the genus is found virtually everywhere in North America. Garter snakes can be encountered within the Arctic Circle of Canada, where the soil is hard and breeding seasons short, heading south across the sunbaked deserts of the American southwest, and ultimately reaching the neo-tropical jungles of Central America.

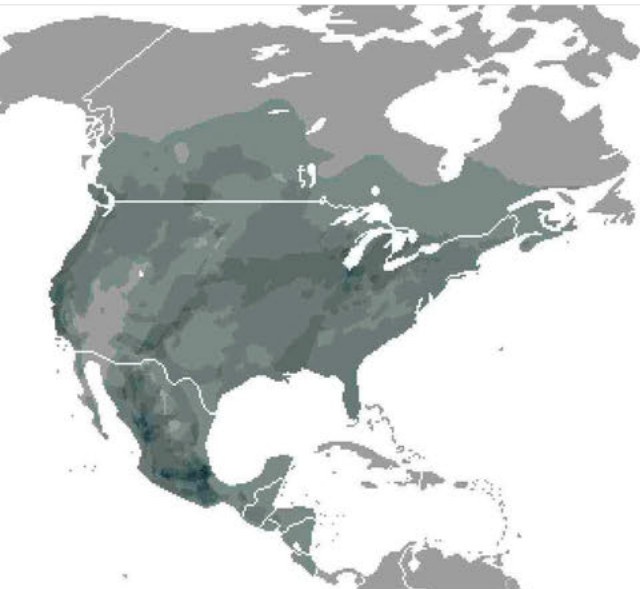


▲ Eastern garter snake. Its range extends right down from Canada to the Gulf of Mexico, and it can even be encountered in urban areas.

▼ *Thamnophis* species are found over a wide area of northern and Central America. Map courtesy IUCN Red List of Threatened Species, species assessors and authors of the spatial data.



A plains garter snake. These snakes may hunt in water.



Biomes and ecosystems across the entire continent play host to species of *Thamnophis*. Masters of adaptation, these snakes have conquered the swamps and glades in central Florida, the high-altitude deserts and arid mountainsides of central California, and they have mastered the hardwood forests of the Appalachians, among other habitats.

Such masters of adaptation are these snakes that annually, in Manitoba, Canada, a mass awaking occurs, in which tens of thousands of red-sided garter snakes (*T. sirtalis parietalis*) all emerge at once from granite pits in the wilderness near the town of Narcisse. This spectacle draws many thousands of wildlife enthusiasts to the park at Narcisse to witness this remarkable phenomenon. Meanwhile, locals in the region become

tired of finding these snakes in their homes, be it in their sinks or shoes every year after the snakes emerge from their winter slumber.

Physical characteristics

In terms of their physical biology, garter snakes are very lithe, swift-moving serpents that seldom coil or twist around their prey (or around their keeper’s hands in the captive environment). The scales along the dorsum are heavily keeled, while the scales along the vent seal very tightly and closely together, making the snake very adept at escaping the grip of predators.

Garter snakes are active almost exclusively during the daytime. Their skull structure is highly adapted to a diurnal lifestyle. The enlarged ocular sockets allow for the snake’s slightly



▲ Garter snakes have relatively large eyes, and very keen eyesight, helping them to hunt during the day.

oversized eyes to view its surroundings through an angle of nearly 180°. A garter snake can simultaneously see in front of itself, to the sides, and nearly fully behind its head with ease.

This impressive visual range is not the greatest that exists among colubrid species, but it is significantly more than most other species of snake on the planet can boast. This field-of-view allows a wary garter snake both to stalk its prey and stay on the lookout for would-be predators all at the same time.

Moreover, the pupils of the garter snake are oversized, which allows the snake to see a staggering level of detail, or even detect the slightest indication of movement by potential prey items at a distance away. The impressive eyesight and the swift movement of the garter snake work in tandem to make these snakes superior active, visual hunters in daylight.

Modest in size, even the largest of the species, which is the aptly named giant garter snake (*T. gigas*) found in the vicinity of San Joaquin, California, only grows to a maximum length of 160cm (63in). At such lengths, these snakes still retain their sleek, lithe bodily form. More typical adult lengths for most species range between 51-82cm (20-32in). Males of the species tend to be slightly larger in size than the females, though this is not always the case.

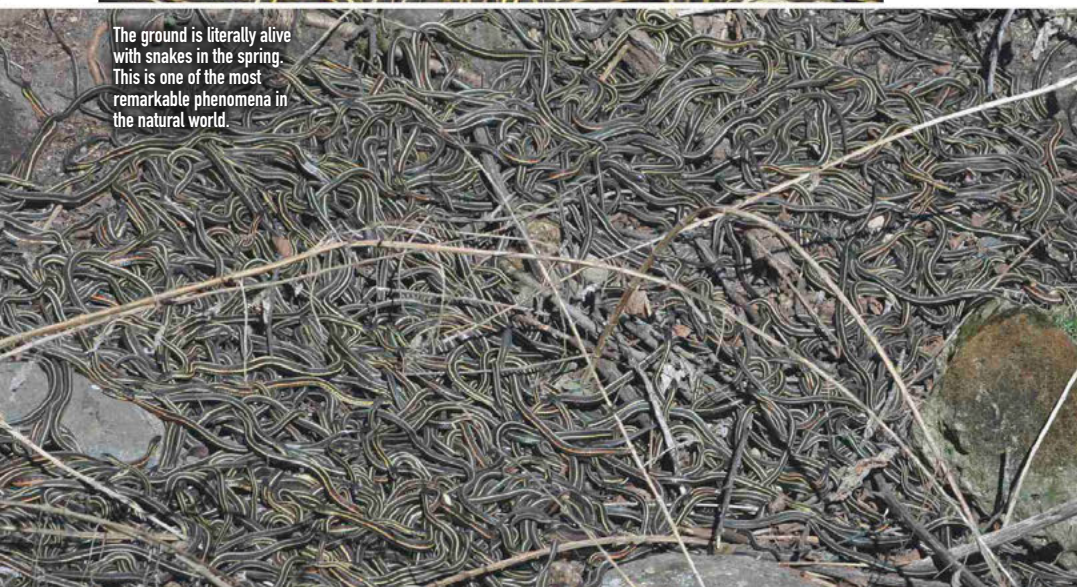
Staying alive

When it comes to self-defence, the garter snake is equipped with a very full bag of tricks. It will rely on its superior eyesight to spot would-be predators and move out of harm's way whenever possible. When pre-emptive escape is not an option, this snake is capable of lying perfectly still for long periods. Its coloration – although this may seem bright and vivid in relative isolation in a vivarium – actually grants an exceptionally good degree of camouflage in the wild; the interstitial flecks of yellow and orange blend very well with last year's dead leaves lying on top of the forest floor, for example.

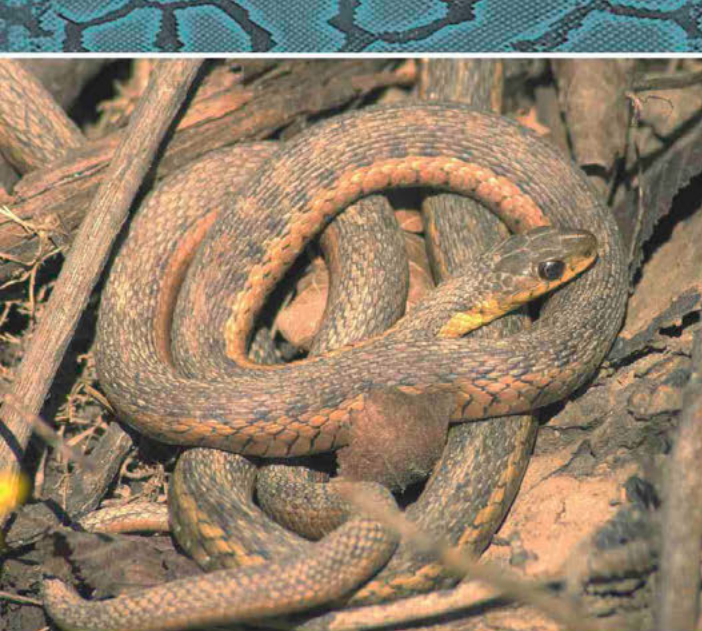


A Garter snakes rely to a very significant extent on their keen eyesight, both to hunt and avoid predators. A red-sided garter snake is shown here.

◀ Communal mating behaviour is seen in red-sided garter snake when they emerge from hibernation.



The ground is literally alive with snakes in the spring. This is one of the most remarkable phenomena in the natural world.



Based on the number of heavily scarred specimens that I have encountered in the wild, I am very inclined to believe that this thrashing, violent behaviour is a successful, life-saving tactic.

If this deception fails to confuse, the snake will then attempt to use its speed and high degree of manoeuvrability to flee and elude its pursuer. Few species of North American colubrid, excluding the racers (*Coluber* species), are as fast as members of genus *Thamnophis* when in flight. A final option for escape, when all else fails, is to twist violently, thrash, empty its cloacal contents, and bite repeatedly.

This is in stark contrast to the evolutionary strategy that many other snakes employ, in terms of coiling about or constricting their attackers. Based on the number of heavily scarred specimens that I have encountered in the wild, I am very inclined to believe that this thrashing, violent behaviour is a successful, life-saving tactic.

Dietary matters

A final aspect of garter snake evolution is this animal's vastly varied diet. Most snake species, by comparison, have a limited range of fare on which they may thrive: small birds, mice, and other small rodents. They are specialists. Garter snakes, however, will thrive on virtually anything that crosses their path: insects and spiders, earthworms and grubs, small rodents and warm-blooded fare, small lizards and other snake species, tadpoles, and even fish are on the menu.

Two especially unique adaptations, which are seldom seen in other serpents, are firstly the garter snake's ability to withstand the poison glands of certain species of frogs and toads. While these skin toxins are enough to repel virtually all other species of snake, the garter snake is not deterred.

A second, very unique survival characteristic comes from the fact that garter snakes have recently been observed feeding on carrion and roadside kills. Snakes generally will not scavenge in this way, in contrast to some lizards. However, such opportunism when it comes to feeding is clearly one aspect of how these snakes conquered virtually an entire continent in a way that no other genus has done.

▲ The colouration of garter snakes helps to conceal their presence.

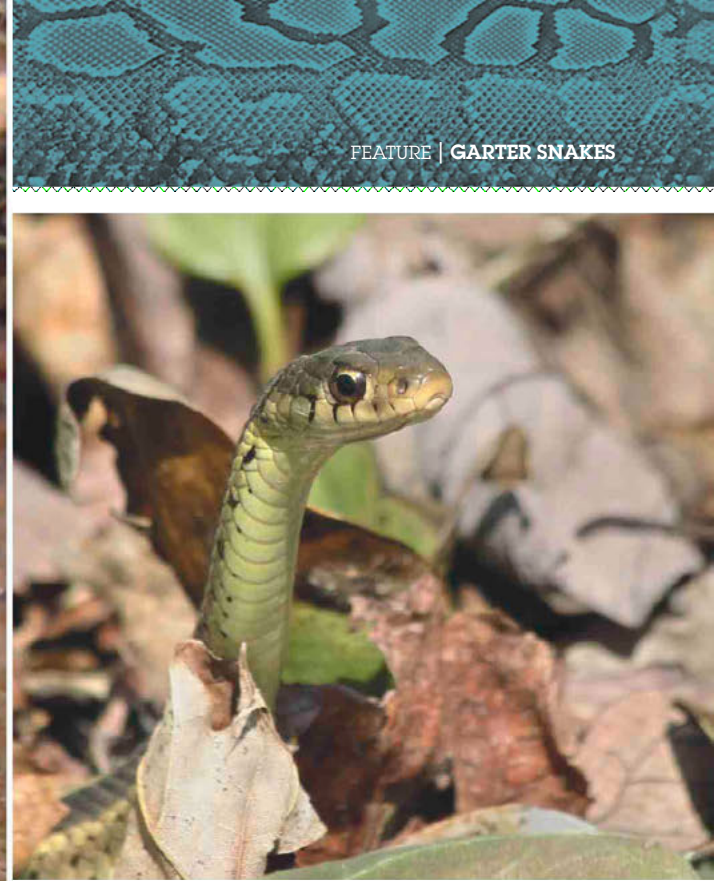
► A black-necked garter snake (*T. cyrtopsis*). This species occurs in southwestern parts of the USA and is often found close to water, where it may hunt.



▲ Garter snakes are able to overcome the chemical defences of amphibians.

► It is now clear that garter snakes are often attracted to the vicinity of roads to scavenge for food.





▲ Dry leaves can be used to replicate the way in which garter snakes may choose to conceal their presence in the wild.

Another cause of stress can be the size of the vivarium. Unlike many species of snake that stay coiled for long periods of time, or which hang from branches and live a more typical reptilian lifestyle, garter snakes are (secondly only to the cribos and racers), very active serpents that may move and slither for long periods, being often on the move. Various subspecies of the western terrestrial garter snake (*Thamnophis elegans*) are so well known for their constant activity that these particular snakes are even called “wandering garter snakes” for this reason.

The practical consequence of such behaviour is that it can make purchasing an adequately sized vivarium difficult, as an enclosure that would work well for a 100cm (40in) long colubrid such as a corn snake or king snake, for example, can be drastically undersized for the movement requirements of a similarly-sized garter snake. And, of course, this size problem in turn can create a space problem for the hobbyist. Where to keep such a large tank? ➤

▼ Garter snakes are often not keen on being handled, in contrast to most colubrids. Youngsters as shown here can become more friendly over time.



Keeping garter snakes

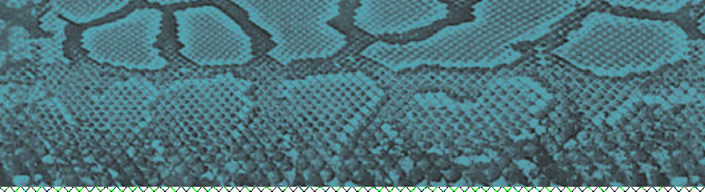
There are several major considerations that potential keepers must face before they take the plunge as responsible owners of this group of snakes. First of all, garter snakes defy many of the elements that make colubrids so popular among herptile hobbyists. While many species of colubrid are famous for being generally well-disposed to being handled – coiling around their keeper's hands, hanging about their keeper's necks, or simply enjoying the ambient warmth of their keeper's touch for example – garter snakes generally seldom enjoy close contact of this type.

Most individuals, irrespective of the species concerned, are wily, withdrawn and skittish, and they like to stay constantly on the move while out of their vivarium, rather than being restrained. Particularly wary specimens can also make sudden and totally unforeseen lunges forward into space, launching themselves from their keeper's grasp.

Therefore, if you are in the market for a species that is very amenable to handling,

then the garter snakes may not be the best option. But, as I mentioned at the start of this article, these snakes are likewise unique in that in vivarium surroundings, they will often replicate hunting and prey-subduing activities in ways that few other colubrid species will exhibit. Thus, if you are a hobbyist, much like myself, who very much enjoys housing snakes in a very naturalistic habitat and encouraging natural behaviours, then some species of garter snake can be a near-perfect choice for you.

There is another consideration that must be tackled as well. Housing a garter snake requires the highest level of security, because these snakes are adept escape artists. Highly stressed specimens, such as those housed under inadequate living conditions, will attempt to escape repeatedly, often injuring themselves in these surroundings. For example, they may rub their noses raw on the glass or the harsh metal screen of the vivarium lid, until the stress factors are reduced, typically by the provision of adequate retreats in their accommodation.



But it is worth pointing out that not all *Thamnophis* species are prone to this specific behaviour. You must research the habits of any particular member of the genus that appeals to you though, with this possibility in mind. Yet perhaps the most crucial aspect of garter snake husbandry to consider is the fact that each and every species and sub-species of the genus *Thamnophis* has a highly unique set of care requirements which differ from those of its relatives: these embrace areas such as levels of relative humidity, temperature, substrate, diet, lighting, and other such needs.

This extreme diversity in their housing requirements is essentially a reflection of the wide range of habitats within the New World where they are to be found. This forces keepers to do a considerable amount of additional homework on the extremely specific and individual needs of their chosen snake. Indeed, this is the first time, over the course of many years of writing about snakes and their care, that I am unable, and entirely unwilling (both for the benefit of the keeper and the snakes themselves), to prescribe even a generic set of living conditions that may be required, before a more permanent vivarium is established.

As a result of the large number of variables in play, you must do your own research into the climatic aspects, so as to replicate the exact living requirements of your snake, and the vivarium set-up must be established in advance of acquiring your snake. The internet can be very useful, in finding out about weather conditions in certain areas for example.

Popular species

The localisation of many subspecies – and even species – can be a frustrating element of keeping garter snakes, by affecting their availability. While ribbon snakes or the checkered garter snake (*T. marcianus*) typically rank amongst the most commonly available, other forms, such as the blue-striped garter snake or

➤ A wandering garter snake (*T. elegans vagrans*).



▼ The red-sided garter snake (*T. sirtalis parietalis*) is particularly colourful.



A Gulf Coast ribbon snake (*T. proximus ornatus*).



some of the vibrantly coloured and highly prized Californian species, are typically much more difficult to locate. Even when they can be found, these animals tend to command a hefty price. Some hard-to-acquire species can sell for several hundred pounds, while those that are more commonly-kept, such as the checkered garter snake or the common garter snake, may cost £30- 50.

The widely-kept checkered garter snake hails from central regions of the United States, and is a large species, capable of growing to 110cm (43in). As its name suggests, its dorsal colouration looks very much akin to a checkerboard: atop a base of tan with a dorsal stripe of tan to yellowish, this snake wears a coat of alternating squares of tan and black running very uniformly along its back.

Like most other garter snake species, the vent is colored tan to sandy-yellow, so that the snake may better blend with its surroundings. Although they are not the most handler-friendly of garter snakes, they are extremely hardy and also long-lived: adult specimens may thrive for well over a decade in the vivarium surroundings. Likewise, this species can be weaned over time on to small rodents



► The checkered garter snake displays striking patterning.

The stunning appearance of the blue garter snake is captured in this photo.



as a food source, which can be helpful in some cases.

House this species in spacious surroundings (which are generally as long as the length of the snake's body or longer at maturity) with a loose, light substrate and plenty of terrestrial hides, such as PVC tubes, half-tubes or the more naturalistic style of hides sold in pet shops. Low levels of relative humidity above ground are recommended (although moistened hides are always required), with plenty of cover throughout, where this snake can shelter and feel secure.

Checkered garter snakes kept in open or poorly designed vivariums are prone to suffering stress and will not feed well. Widely-considered as the best species for beginners, this particular garter snake is often available in albino forms in pet stores and breeders.

Blue garter snake

A second species of garter snake that is noteworthy in the hobby – quite apart from being my personal favourite! – is the blue garter snake (*T. sirtalis similis*). Native to the swamps and lowland glade forests of northern Florida, this species wears a similar checkerboard pattern as the checkered garter snake, but with a base coloration and stripes of azure hues. This is simply a gorgeous species; being that blue is such a rare colour in the world of snakes, this one is definitely one to have on your list!

In terms of its care requirements, this species may be maintained on a loose, sandy substrate with high levels of relative humidity and relatively high temperatures: the ambient figure in its

quarters should be between of 28-29°C (82-85°F) with basking spots reaching 32-33°C (90-92°F). These snakes are highly piscivorous, and I feed mine on guppies, which I breed for this purpose, to ensure that the fish are healthy as far as possible.

Many hobbyists feed these snakes on small goldfish, but the scales and fins of some goldfish can irritate the snake's oesophagus and cause health problems over time. Meals comprised of several smaller guppies are preferable, compared with feeding a larger goldfish. Simply place the fish in the snake's water dish; the blue-striped garter snake will smell the prey and be attracted here. Obviously, all piscivorous or semi-aquatic snakes needing an over-sized, deep, water dish should have one that is equipped with sloping sides. They must be able to emerge from the container easily, with no risk of becoming trapped in the dish.

Did you know?

Feeding garter snakes on fish, especially without using a vitamin supplement, can be dangerous. This is because various types of fish (including goldfish) contain an enzyme called thiaminase. It breaks down vitamin B1 (also known as thiamine), and ultimately, the snake will develop neurological signs as a result, and may start convulsing. If uncorrected, this deficiency will be fatal. Trout is a good option though, if you can persuade your snake to take strips of this fish, as it does not contain thiaminase and is readily obtainable.

Another plus to choosing the blue-striped garter snake is this species' attitude towards being handled; it is much more tolerant than many other garter snakes in this regard, and hobbyists report long periods of handling without the thrashing, constant movement, and mild anxiety that is common when handling many other related species.

One of the only drawbacks, however, is the limited availability of the blue-striped garter snake in the hobby. This is something that you need to bear in mind, and have a set-up readily for the time when stock is available. If a truly gorgeous, deeply blue-skinned snake is the snake for you, then this species is definitely worth the wait.

Common garter snake

The final species I wish to mention is the common garter snake, which consists of a significant number of subspecies. The diversity within this group makes it very difficult to give precise housing or dietary tips for the species as a whole, as it is represented in so many niches across North America.

The common garter snake is a hearty, beautiful animal that embodies all the "classic" elements that have made this group of snakes so popular among keepers through the years: the dorsal coloration is dark brown to black with interstitial flecking of yellow, orange, or even bright red to accent their beauty. Individuals are highly individual in their appearance. The dorsal stripes are bright yellow and the lines of this snake are very clean and crisp, giving it the striking polarity of bodily coloration that many hobbyists find so attractive.

Dealing with the common garter snake is tricky, however, based on the diversity that exists within the species. So many sub-species hail from different environments. The same demand to self-educate that is made of the keeper when considering how a particular species should be kept is further magnified in this case.

Some of the best resources for learning more about the particular requirements of individual species and subspecies of the garter snake include *Garter Snakes and Water Snakes* (2005) by David Perlowin, *Garter Snakes: Evolution and Ecology* (1996) by Rossman and Ford, and *Quick & Easy Garter & Ribbon Snake Care* (2005) by me, Phil Purser.

Colour morphs are rare in garter snakes. This is an albino form of the eastern plains garter snake (*T. radix*).

It is interesting how there is a tendency to stereotype the species of snakes that available to hobbyists today. So often, we segregate some species of snake as being "just-for-beginners" when, in fact, many of these species have so much more to offer to the advanced or serious herp enthusiast. While certainly, some species of garter snakes are good choices for younger hobbyists or those of any age who are starting out with snakes, they offer much more. They provide a wide range of ecological insights and the chance to observe natural behaviour patterns in vivarium surroundings that cannot be seen in the case of other colubrids.

In a saturated market of what are effectively genetically-modified species and reptiles that are bred in large numbers to satisfy a growing yet non-diverse market, garter snakes still have one trick up their sleeve. In addition to their captivating behaviour and their amazing, vibrant beauty, these snakes also offer keepers a great sense of the natural wonder and awe – such as I felt that day so long ago when I turned up that small common garter snake on the edge of my father's garden. It is a feeling that is hard to replicate in the hobby these days, being increasingly confined to more remote areas of the reptile-keeping world. ❖

About the author

Dr. Philip Purser, Ph.D. has been a keeper of snakes for nearly 30 years. Among his favourites are the rattlesnakes. Dr. Purser currently lives in Tampa, Florida, where he is an assistant professor at Hillsborough Community College.

Common garter snakes vary widely in appearance, being found over such a wide area.

A venom discovery!



The boomslang is a colubrid that possesses potentially deadly venom.

It has long been known that a select few species of colubrid snake are venomous. The mangrove snake (*Boiga dendrophila*) and 33 other members of the genus *Boiga* are well-known venomous colubrids, with the impact of their venom ranging from being a mild irritant to a serious threat to human life if left untreated.

Another mildly venomous group of colubrids are the rear-fanged members of the genus *Heterodon*, also known as the hognose snakes. Certainly, the most infamous venomous colubrid is the much-feared African boomslang (*Dispholidus typus*), which claims a number of human lives every year throughout its range in Africa.

Until recently, no one thought that garter snakes were part of this venomous sub-group of colubrid snake species. However, in the early 2000s, it was discovered that garter snakes do, in fact, produce a small load of very mild venom. This, however, poses no threat to human handlers, as these snakes lack the dentition to inject their venom through a membrane as thick as human skin.

It requires an exaggerated chewing action on the snake's part to force this venom into the open wounds created by its teeth puncturing through the skin of its prey. Indeed, it is now becoming clear that many species of snake which herpetologists have long considered to be non-venomous are, in fact, venomous to a very mild extent.



The western hognose – this is a pink pastel albino morph.

Do not let this knowledge inhibit a desire to keep a pet garter snake, however. Indeed, the western hognose snake (*Heterodon nasicus*) has long been known to produce mild venom, yet it has been a very popular pet species for both adult and young hobbyists alike for decades.

It is generally believed that evolution is a slow process, taking place over many thousands of years, but now American researchers have shown things can be speeded up dramatically under certain circumstances.

Scientists working on islands off the coast of Florida have documented very rapid physical changes in the case of the green anole. This change has occurred in as little as 15 years, as a result of pressure from the invading brown anole, which has been introduced to the area from Cuba, although it is also to be found on the Bahamas.

Heading upwards

After contact with their invasive relative, the native green anoles began perching further up in the trees on these islands, and, generation after generation, their feet evolved to become better at gripping the thinner, smoother branches found at higher levels.

The change occurred at an astonishing pace. Within a few months, native lizards had begun shifting to higher perches, and over the course of 15 years and some 20 generations, their toe pads had become larger, with more sticky scales on their feet.

"We did predict that we'd see a change, but the degree and speed with which they evolved was truly surprising," admits Yoel Stuart, a postdoctoral researcher in the College of Natural Sciences at The University of Texas at Austin.

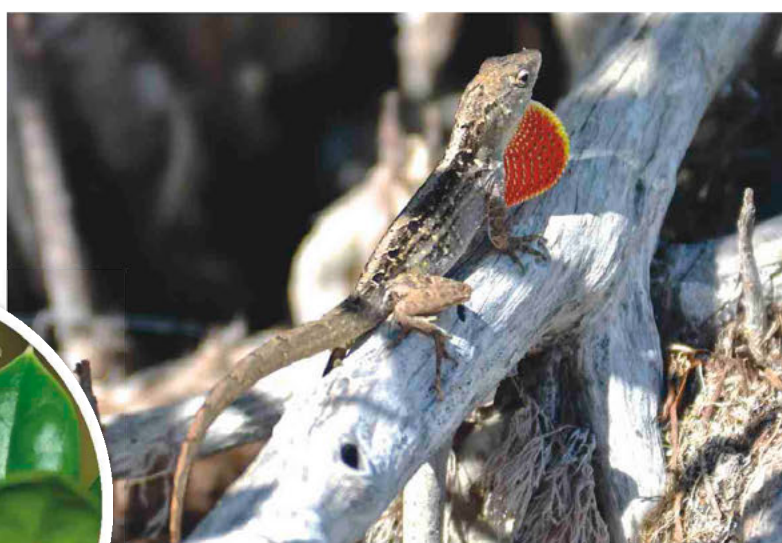
"To put this shift in perspective, if



The green anole has adapted rapidly, in terms of its climbing abilities.

FAST-TRACK EVOLUTION IN LIZARDS

► The brown anole is encountered at lower levels.



▲ Green anoles can catch insects at higher levels off the ground as a result of this change.

human height was evolving as fast as these lizards' toes, the height of an average American man would increase from about 1.75m (5 feet 9 inches) today to about 1.93m (6 feet 4 inches) within 20 generations — a dramatic shift" he explains. "Although humans live longer than lizards, this rate of change would still be rapid in evolutionary terms."

Avoiding competition

Brown anoles first appeared in south Florida during the 1950s, possibly as stowaways in agricultural shipments from Cuba, and they have since spread across the southeastern part of the USA and have even jumped to Hawaii.

This latest study is one of only a few well-documented examples of what evolutionary biologists call "character displacement," in which similar species competing with each other evolve differently to take advantage of separate ecological niches. It allows them to survive without competing directly in the same restricted environment.

A classic and well-known example of this type comes from the finches

studied by Charles Darwin. Two species of finch in the Galápagos Islands diverged in beak shape as they adapted to different food sources.

The researchers speculate that the competition between brown and green anoles for the same food and space may be driving the adaptations of the green anoles. Stuart also noted that the adults of both species are known to eat the hatchlings of the other species.

"So it may be that if you're a hatchling, you need to move up into the trees quickly or you'll get eaten," adds Dr Stuart. "Maybe if you have bigger toe pads, you'll do that better than if you don't." ♦

The left hind foot of the green anole after evolution. Toe pad measurements were taken on the expanded scales at the end of the longest toe. Photo courtesy Yoel Stuart/University of Texas at Austin.



Further information

Y. E. Stuart, T. S. Campbell, P. A. Hohenlohe, R. G. Reynolds, L. J. Revell, and J. B. Losos. **Rapid evolution of a native species following invasion by a congener.** *Science*, October 2014 DOI: 10.1126/science.1257008



TALES FROM THE REPTILE HOUSE

The snake inside the spare wheel

Having worked for many years as the curator of a zoological collection in Scotland, Bill Lowe somehow always found that snakes and reptiles would often make an appearance in his life when he was least expecting them to do so. It didn't seem to matter that he wasn't supposed to be at work ...

I don't know why it should be, but reptiles seem to pop up in my life all the time. Working in the Reptile House, I was surrounded by snakes, lizards, amphibians, tortoises, terrapins, spiders and all manner of invertebrates, but come on, sometimes a guy deserves

▼ Snakes were often to be seen where Bill's new home was located.

a rest from reptiles – even if it is only for a couple of weeks on holiday!

I suppose therefore that purchasing a holiday home in Northern Cyprus was never going to be a good idea if I really meant that what I wanted was an “away from it all location”, especially if the bungalow that I purchased was situated half way up a mountain in a garden strewn with large boulders and deep crevices between countless rocks, providing a haven for all manner of snakes and other reptiles.

It wasn't until shortly after I had purchased the property that I learnt from the locals that the land upon which my recently acquired house was built had long been known as “the snake pit”. I quickly realised that my “get away from it all” destination was always going to be a bit of a busman's holiday.

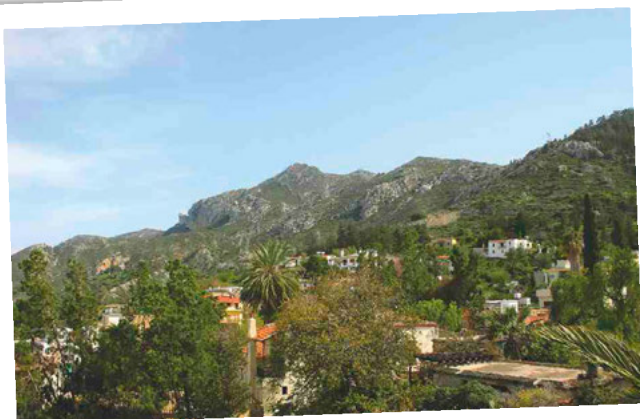
If I am honest, I really did not mind because, by then, snakes were in my psyche, spiders had already lured me into

their web, lizards I looked upon as friends and I had long since been converted to invertebrates.

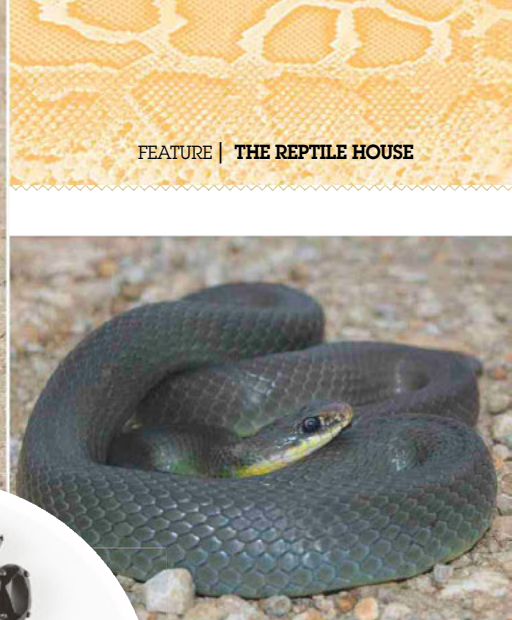
An early introduction

My very first encounter with a snake on the island was with a large whip snake (*Dolichophis jugularis*). As their name suggests, they can grow to a large size. I subsequently discovered that they would often be seen sunning themselves on the single tarmac road which led out of the village. Such was the typical length of one of these snakes, that from head to tail, an individual would often stretch right across from one side of the road to the other when on the move.

They reminded me of a very large version of the black rat snake (*Elaphe obsoleta*) – the first foreign species of snake I ever kept after “graduating” from the grass snakes that I used to find in the meadows and around the ponds which formed part of the estate surrounding the



A large whip snake, which is so-called in part because of its tapering body. Throughout Europe, Asia and the Americas, a wide range of different serpents are described as whip snakes.



A black mamba – the black rat snake often acted as a film double for this deadly species.



▲ A Victorian jet mourning necklace. The appearance of this stone reminded Bill of the colour of his rat snake – but this species does vary in its depth of colouration.

Photo courtesy DetlefThomas

▲ A relative of the large whip snake, in the guise of the eastern yellow-bellied racer (*Coluber constrictor flaviventris*), this species is also sometimes confused with the black mamba, although again, as with the rat snake, these species come from different continents.

scales and has a powerful, slender shaped body with a wedge-shaped head.

Newly-hatched rat snakes are of a paler grey coloration, with patches of black running along the back. As an individual attains maturity, the areas of black intensify. Inexperienced herpetologists sometimes confuse hatchling black rat snakes for those of copperheads, on account of their similar skin patterning.

Lifestyle

Contrary to popular opinion that rat snakes prove to be quite shy, retiring creatures tending to freeze and remaining motionless if confronted with any perceived danger, my initial finding was that of a charming little snake which would readily accept my handling, as long

▼ The first 'exotic' snake that Bill kept was a black rat snake.

hotel on the outskirts of Edinburgh where I was free to roam as a child.

I had been put up for adoption after being born during the closing stages of the Second World War. At the time when I came into their life as a small baby, my adoptive parents were already well into their fifties. I grew up having to rely very much on my own company, as my "cousins" were a good deal older than myself. It was therefore to the creatures that inhabited the acres of grounds that surrounded the hotel that I turned to for companionship most of the time.

My initial choice

My first rat snake was jet black in colour and reminded me of the black jet necklace that my grandmother used to wear around her neck. It had been given to her by an elderly relative who lived in Whitby, East Yorkshire where this type of stone originated. Jet had been popularised by Queen Victoria following the death of her beloved Prince Albert, as a classic means of signifying a period of mourning.

With its inky black incandescence, its colouring closely resembled that of my black rat snake, which I sometimes used to wrap around my neck in much the same manner as my grandmother used to display this favourite item of her jewellery!

Rat snakes are an ideal first acquisition for anyone new to the hobby of reptile keeping. They are perfectly docile, often doubling up for venomous species, such as the black mamba, in a variety of Hollywood films. Likewise, impersonating

venomous species, rat snakes have appeared in the James Bond films and they had a prominent role in *Raiders of the Lost Ark*, as well as many other box office hits.

As its name implies, the black rat snake is black in colour – albeit not completely so, as it sports a conspicuous white chin. Typically measuring up to 6ft (1.8m) in overall length, it is covered with keeled



as I was gentle and avoided any sudden movements.

In the wild, it is true that an individual may protect itself by coiling its body up into a tight ball and vibrating its tail in an attempt to simulate a rattlesnake. Rat snakes are also capable of producing a foul-smelling musk and releasing this substance if attacked by any would-be predator, spreading the musk around with the tail.

As the name would suggest, these snakes are predominantly rodent eaters, although they will also take small lizards and amphibians. Adults have also been documented hunting chipmunks and moles, overcoming their prey by means of constriction. Nestlings and birds' eggs form part of the diet as well. In vivarium surroundings, however, they can be sustained on mice, day-old chicks and small rats.

Breeding behaviour

As is the case with most snakes, rat snakes lay eggs, emerging from their hibernation between the months of March and May, and seek out a mate, typically towards the end of April or early May. The male will usually lie in wait for a passing female, relying on her pheromones to detect her presence, whereupon he will initiate the act of copulation.

He will come alongside her and attempt to wrap his tail around hers in such a manner that their vents are almost touching. Some males will grasp their intended mate by "capturing" her by the mouth, thus holding her in one place and preventing her from moving away until mating has taken place.

Spurred on by such close physical contact, he will erect his hemipenes before inserting one of these organs into her cloaca and anchoring it into place by means of a series of small spines. Mating may take only a matter of a few minutes,

► In the spring, basking on warm stones helps black rat snakes to acquire heat.

▼ The patterning seen in black rat snakes and copperheads (as shown here) helps to conceal the presence of these snakes in the wild.



▼ A mating pair of rat snakes.



or it can last for several hours.

Approximately five weeks later, the female will produce a clutch of eggs numbering from

12 to 20. They will typically be well hidden, being deposited under a hollow log, or amongst dried leaves, or sometimes deep inside the abandoned burrow of some small mammal. If conditions remain favourable, the female will often go on to produce a second

clutch.

Once they emerge from the eggs, the hatchlings quickly become independent, and will forage voraciously for insects and small invertebrates, doubling their size in no time at all.

Deadly myths

Rat snakes are deemed to be quite useful to have around agricultural buildings and their presence is usually encouraged in farming communities, as they help to control the population of rodents. Sadly, although they do no harm to humans, they are often persecuted through ignorance though.

I soon learnt that persecution of snakes (either venomous or non-venomous) is very much a matter of course in Northern Cyprus, where the local Turkish Cypriot population commonly believes that all species are deadly and that, if you are bitten, then you have very little chance of survival.

Strangely enough, and contrary to this widely held belief, there is only one species to be found on the island which justifies this inherent fear. This is the blunt-nosed viper (*Vipera lebetina*), which is commonly to be found inhabiting steppe-like terrain, dotted with boulders and bushes – exactly the type of landscape on to which my bungalow looked out.





▲ The *kofi* reputedly looks rather like the gaboon viper, which is a species present on mainland Africa, however, rather than on Cyprus.



◀ Black rat snakes are typically welcome around agricultural buildings where rodents such as rats are present.



This is highly venomous species. It has a short, fat, thick body shape with a horn-like tail end. In terms of coloration, individuals can vary enormously, although sandy brown and yellowish colours predominate, helping it to blend into the hot, dusty landscape.

A mystery snake

I had been told by some of the older Turkish Cypriots that another similar, but much larger, species existed on the island, but could find no written information to verify the truth of its existence.

I had once been shown an old

photograph of one that had supposedly been caught and killed in one of the local villages. The image depicted a much larger snake, which was obviously a viper, although I have to admit that the photograph in question could have been taken anywhere and not necessarily on the island.

It was locally known as the *kofi*, and, rumour had it, that if you were bitten by one of the snakes, your chances of survival were reputedly very remote. I did not know whether to believe these tales or not, as the snake in question looked to me rather like a gaboon viper (*Bitis gabonica*),

which naturally hails from the African continent.

I never found any trace of the true existence of this snake until one day, some 20 odd years later, walking towards a remote stretch of beach with my three dogs, I stumbled across the remains of a very large snake, which, to my mind, closely fitted with that description and the photograph that I had been shown all those years ago.

Unfortunately, as is often the case on such occasions, I did not have my camera with me. The carcass was already under attack by an army of ants and much of the body structure had been eaten away and the head of the creature was disfigured as a result of having been squashed under the wheels of what was probably a passing jeep.

Unless the blunt-nosed viper which is known to inhabit the island and which I have personally observed on more than one occasion, is subject to the phenomenon described as "island gigantism", then I do not know what it was that I found that day. Having been involved with reptiles virtually all my working life, I am not prone to exaggerating what it was that I might have seen that day and I guess that I will never really know the answer.

It appears that the locals are aware of this creature's existence on the island, but any scientific support for this appears to be totally lacking.

Deadly vipers

Returning to the subject of a species that very much does exist on the island, I was once privileged to watch the courtship display of a pair of blunt-nosed vipers. This took place virtually on my doorstep in the middle of the dusty track that led to my bungalow.

Coiling themselves around each other in an elaborate dance that involved raising most of their bodies off of the ground, the pair twisted and turned around each other in a series of sensuous movements, with this display continuing for several minutes.

It may have been the case that what I was observing was two rival males vying for the attention of an unseen female though, as the two forms of display are very similar.

If one of these deadly vipers is disturbed, it will hiss loudly and it may spring to attack very quickly, giving very little warning that it is about to strike. Nevertheless, the risk is probably exaggerated locally, as I have no knowledge of any human snake bite fatalities on the island over the past 20 years of so.

However, having been involved heavily in the Kyrenia Animal Rescue (KAR), I do know of many dogs that have not survived after being bitten by one of these snakes. I was always somewhat anxious about walking my own dogs along the stretches of hinterland behind the more deserted beaches, for fear that one of my four-legged friends might become a victim of such an attack.

I always carried three vials of anti-venom and syringes around with me in the glove compartment of my car, just in case. In my capacity as curator of the Scottish zoo where I worked for so many years, I had to undergo a certain amount of veterinary training and, therefore, I was in possession of the necessary qualifications and knowledge to be able to administer any such injection that might have been necessary.



▲ Bill's garden, where snakes of different types are often to be seen.

Photo courtesy of the author.



An unwanted passenger

On a previous occasion while holidaying in Northern Cyprus and travelling around in my own open-topped jeep with some friends in a particularly remote part of the island, there was a piercing scream from one of my female passengers. This was around 20 years ago, when there was a much more visible military presence on the island and many more districts remained "no go areas". Uncertain as to the cause of her

distress, I immediately brought the vehicle to an abrupt halt in the middle of nowhere.

My friend, Rita, who had been sitting in the back of the jeep had just looked down at her feet only to see a fair sized blunt-nosed viper nestling between her sandals which she had kicked off in the back of the vehicle. I immediately instructed everyone to get out of the car as quickly as possible. I vacated the driver's seat and began looking for the stowaway, but it was nowhere to be found.

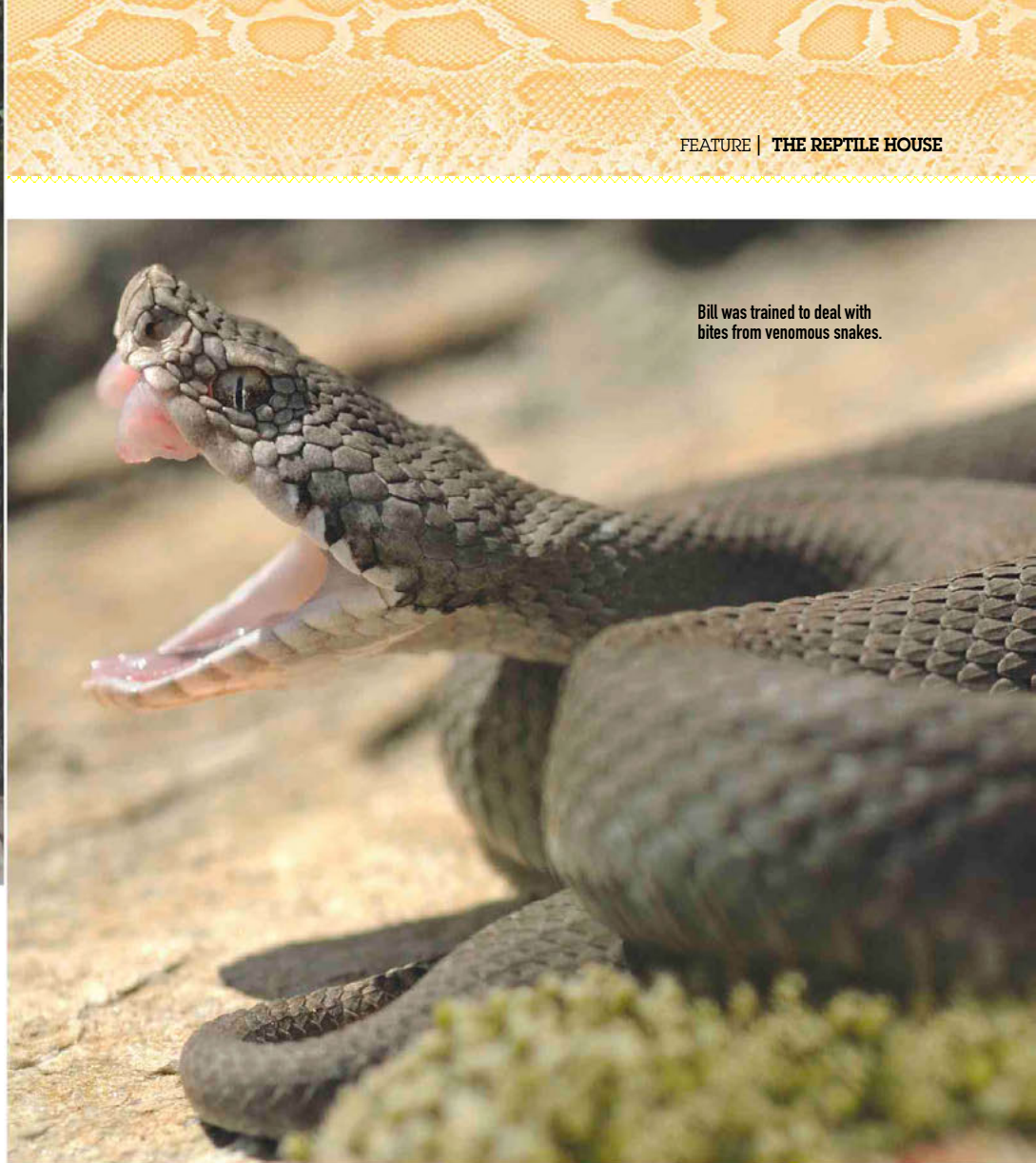
Dogs can often fall victim to snake bites. Even in the UK, several die each year, as the result of bites by adders, usually when they are out walking with their owners.





Not wishing to take the risk of telling my passengers to get back into the jeep before the venomous hitch hiker had been found, I began stripping the rubber mats out of the passenger wells, searching through the folds of the stowaway hood of the open topped jeep and anywhere else I could think to look - all to no avail!

I even managed to enlist the assistance of the occupants of a passing Turkish army vehicle who, armed with spanners and other tools, began dismantling the car seats, stripping the vehicle down in the middle of the hot, dry landscape, so that very soon it began to look as if it was fit for nothing more than the scrapyard. Yet still there was no snake to be found.



Bill was trained to deal with bites from venomous snakes.

Back on the road

Eventually the army lads helped me to put the jeep back together again and, somewhat apprehensively we were on our way once more, eventually arriving back home after this unexpected escapade. By this time, the jeep was absolutely filthy, being covered in dust

both inside and out. I decided that I would occupy the time that it would take for my female guest to get ready to go out for a meal that evening by giving the jeep a well-needed wash.

No sooner had I unwound the hosepipe and starting spraying water over the vehicle than I spotted our stowaway. The viper had been tightly coiled in a circle around the inside of the spare wheel, which was attached to the rear of the vehicle.

It had obviously hitched a ride all the way home with us only to finally be disturbed by suddenly finding itself deluged in cold water. Its colouring provided such excellent camouflage that neither a fair contingent of the Turkish army nor myself had been able to spot it - so well was it concealed in its hiding chosen hiding place.

Other reptiles

From time to time, I would discover more harmless varieties of snakes, as well as various types of lizards and chameleons amongst the branches of the olive trees that grew in my Mediterranean garden.

Usually, I would only ever notice them if they were at the level of my eye. In a parody of the words taken from the Sir Andrew Lloyd Webber musical, *Phantom of the Opera* when forging amongst the



◀ Blunt-nosed vipers are found over a very wide area. This is the Turan form (*M. l. turanica*), which occurs as far east as Afghanistan and Pakistan.

prickly olive branches, I always knew that I needed to “keep a hand at the level of my eye”.

This would always give me the best possible chance of capturing whatever it was that had momentarily caught my attention, before it became lost amongst the foliage once again. I could then take the opportunity to inspect it at close quarters before releasing it in due course. In this way, I could also ensure that should I unfortunately encounter a venomous snake in this way, it was better to be struck on the hand, rather than in the face.

There are other venomous snakes on the island - the Montpellier snake (*Malpolon monspessulaunus*), for example, whose bite will cause localised swelling and nausea. There is also the semi-venomous rear-fanged European cat snake (*Telescopus fallax*), or soosan. The latter has a very long, thin body and is coloured either greenish-brown or beige, with square-shaped markings arranged in a diamond pattern.

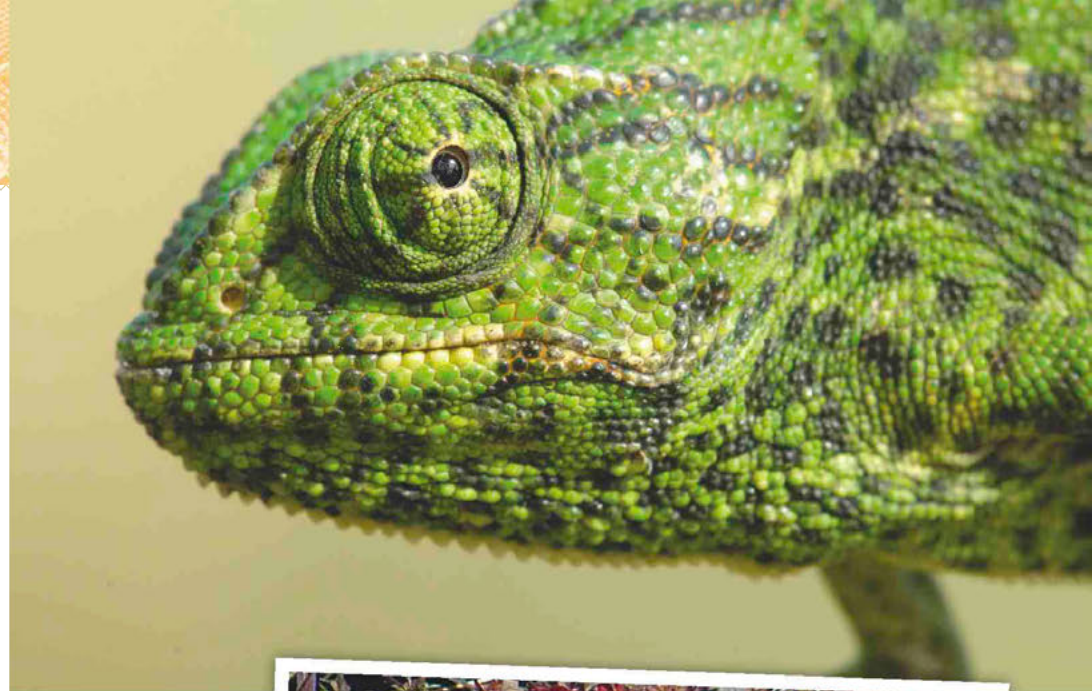
I was able to observe all three of these known venomous snakes whilst I was on the island, although if you're tried it, you will know that spotting reptiles in their natural habitat is not always an easy task.

■ ■ **There are other venomous snakes on the island - the Montpellier snake (*Malpolon monspessulaunus*), for example, whose bite will cause localised swelling and nausea.** ■ ■

▲ **Common chameleons – one of the friendly groups of reptiles found on Cyprus.**

➤ **The Montpellier snake.**
Photo courtesy Hubert Laroche.

▼ **The stunning Mediterranean cat snake.**
Photo courtesy Jeffrey Siberras.




In conclusion

At the Reptile House where I worked for so many years, I considered myself to have been extremely fortunate to have had the opportunity to get up close and personal with so many different species. However, when you are on the lookout for reptiles in the wild, not only do you never know exactly what you might find. At the same time, you may just discover something that you have never have seen before and, possibly you may well stumble across it in the strangest of places. This can bring a feeling of excitement, if not fear occasionally as well!

On that Mediterranean island, I have rescued chameleons dicing with death by walking down the middle of the main road; a whip snake dodging the traffic by crossing a dual carriageway at the busiest time of the day, and geckos hidden deep inside the cracks within the walls of my home, which had been caused by the latest earth tremor.

However, never would I have imagined that a good place to start looking for the most venomous species of snake on the island would be curled up inside the spare wheel of my jeep. It just goes to prove that you never know what you might find in the most unexpected of places! ❖



Puzzle Corner

Find the solutions to these puzzles by following the clues, to discover which reptiles, amphibians or invertebrates are hidden within them. The answers can be found on p66.


REPTILE ID

Can you name this lizard and where it comes from?




Honeycomb

Enter the six-letter solutions to the clues clockwise around the appropriate numbers of the grid so that they interlock, producing a word around the black centre that shows a natural habitat of some turtles. Three letters have been entered to help you start.



CLUES

- 1 Kenny, American country singer.
- 2 Tied up or anchored at berth.
- 3 Curly-fleeced Spanish sheep.
- 4 US five-cent coin.
- 5 Member of the fairer sex.
- 6 Bet, take a punt.




LINKAGE



What are the three things that link the tortoise, snake and rodent shown here?

COUPLETS



Choose two consecutive letters in order from the three circles in each row to form a six-letter word in each corresponding row of boxes. We've given you a start with SELDOM, and a correct solution will reveal the name of a mountain lizard, running down the ringed columns.

WASH	BANG	DYED					
ICON	WASP	BIRD					
BRAY	CUTE	OVAL					
TENT	BEER	GYMS					
SEAT	HOLD	ROMP	S	E	L	D	O
WIDE	LIFT	BUNG					

WHERE IN THE WORLD?

Can you identify each of these tortoises, and the continents where they are to be found?







Herpetological Mysteries



Duvaucel's gecko is native to New Zealand, tending to be localised to smaller, offshore islands, away from introduced predators, but it probably still occurs on North Island too, in small numbers. Photo courtesy Jennifer Moore.

GIGANTIC GECKOS

It's often easy to miss something when it is right in front of our eyes, as Dr Karl Shuker reveals, when he investigates the case of the world's largest gecko.

◀ New Zealand is comprised of two large major islands, known as North and South Island, and lies to the southeast of Australia.

The largest species of gecko that you are likely to encounter today in New Zealand is Duvaucel's gecko (*Hoplodactylus duvaucelii*), which attains a total overall length (from the tip of its snout to the tip of its tail) of up to 32cm (12.75in). Just over a century ago, however, a much more sizeable species could be found there, if a unique and truly extraordinary museum specimen is a reliable guide. Its existence also raises the rather intriguing question - could such geckos still survive in this part of the world today?

Left alone

The mysterious mega-lizard's history begins sometime between 1833 and 1869. It was during this period that France's Marseilles Natural History Museum received a specimen of an unusual lizard from an unrecorded locality. As a mounted, stuffed exhibit, it was subsequently put on open display at the museum - where, for many years, it remained in full view of countless numbers of visitors.

It was also seen on a daily basis by generations of museum staff, and many other members of the scientific

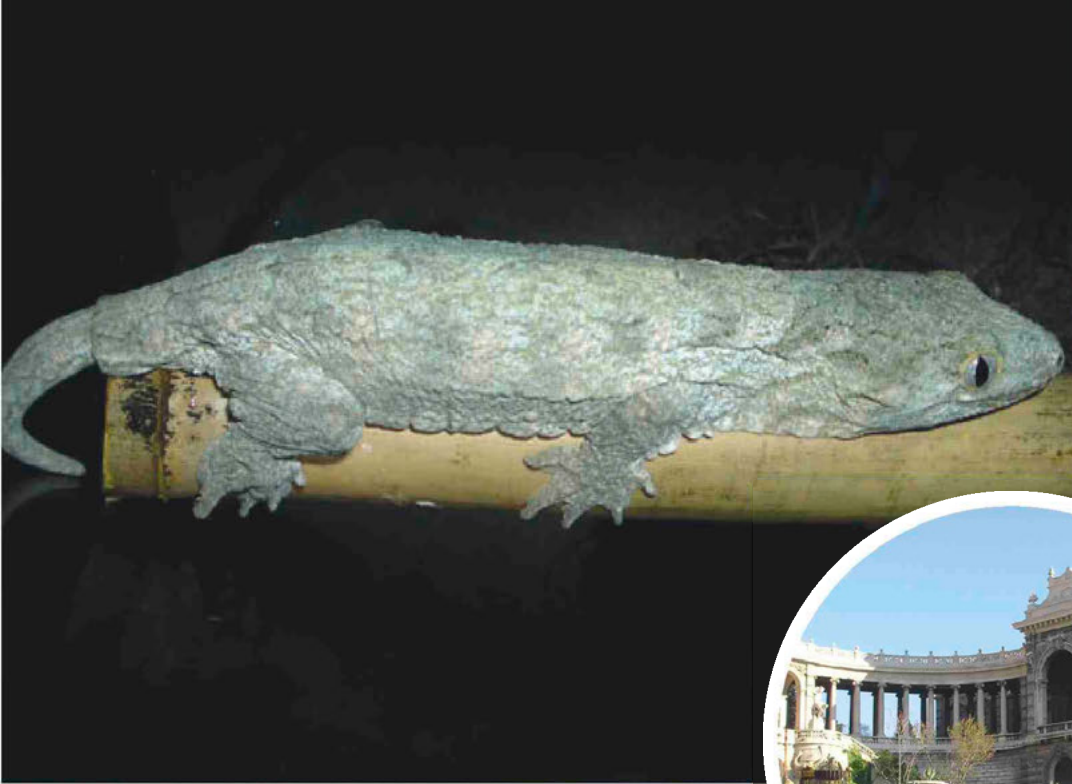
community, who visited and often worked there too. Yet, unbelievably, never once in all that time did anyone realise, or even suspect, that this specimen actually represented a remarkable new species - one that had never been recorded previously by science!

Starting a search

The decades rolled by, but still the ignored lizard's true identity remained undisclosed and uninvestigated - until as recently as 1979, when this strange specimen attracted the curiosity of the museum's herpetology curator, Alain Delcourt. Eager to learn more about it, Delcourt took some photographs, along with the specimen's measurements, and sent this information to a number of reptile experts around the world, in the hope that they would be able to identify the species.

It ultimately reached Canadian biologist Dr Anthony P. Russell, who in turn showed them to Villanova University herpetologist Dr Aaron M. Bauer. Russell and Bauer recognised that the specimen was clearly a gecko, but of grotesquely gigantic proportions, measuring fractionally over 60cm (24in) in total





▲ The New Caledonian or Leach's giant forest gecko was first described back in 1829. It can grow to 35cm (14in) long. Photo courtesy Alfeus Liman AKA Firereptiles at en.wikipedia.

length. This figure is nearly double the size of the world's next biggest species of modern-day gecko, the New Caledonian giant forest gecko (*Rhacodactylus leachianus*).

Tracking its origins

The mystery gecko was a short-headed creature with a bulky body. It had sturdy legs and a long, pointed tail. In terms of

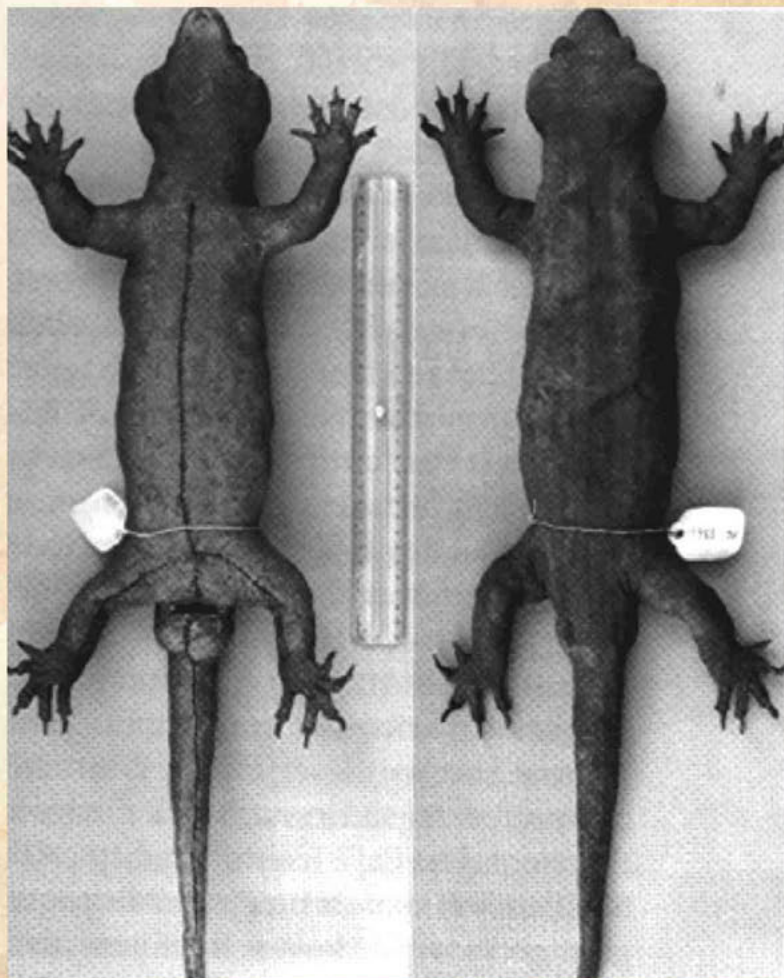
its colouration, it was handsomely marked along its back with dark reddish-brown, longitudinal stripes overlying its yellowish-brown background colouration. In overall appearance, it compared fairly closely with geckos of the genus *Hoplodactylus* - except, once again, for its huge size.

The existence of this enigmatic lizard



▲ The Natural History Museum at Marseilles, where the lizard was put on display. Photo courtesy Moumousse13.

◀ The only known specimen of Delacourt's giant gecko, displayed against a 30cm (12in) ruler. Photocourtesy International Society of Cryptozoology and Dr Aaron Bauer.



► Alain Delcourt holding the type (and only known) specimen of his reptilian namesake, Delcourt's giant gecko at Marseilles Natural History Museum. Photo © Dr. Aaron Bauer.

finally became known to the world at large in 1984, when Bauer's investigations of its possible country of origin led him to New Zealand. And in 1986, the species was formally described by Bauer and Russell. They named it *Hoplodactylus delcourti* - in recognition of Delcourt's efforts to bring this long-neglected gecko back to public awareness, after more than a century of being abandoned in zoological obscurity.

Its identification as a *Hoplodactylus* species had provided an important clue as to where in the world it probably originated, because members of this genus are mostly limited to New Zealand. This clearly suggested very strongly that this country was also the home of the giant *H. delcourti*. Additional support for this conclusion came from Bauer's investigations there, because he learnt that Maori legends spoke of a strange New Zealand creature called the *kawekawau* or *kaweau*.

Myth and reality

Up until that stage, no-one had previously succeeded in linking this mysterious animal with any known species inhabiting New Zealand, although various reports from the 19th century described alleged encounters with such creatures. One of the most detailed of these accounts, documented in 1873 by W. Mair, reported the killing of a *kawekawau* three years earlier in North Island's Waimana Valley by a Urewera Maori chief.

He had informed Mair that it was a large forest-dwelling lizard about 60cm



(24in) long, as thick as a man's wrist, and brown in colour with red longitudinal stripes. This description is clearly a near-perfect match with that of Delcourt's giant gecko.

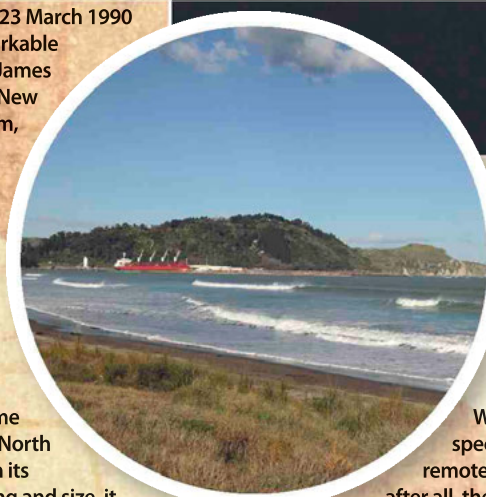
Bauer and Russell thus strongly believe that the *kawekaweau* and *H. delcourti* may indeed be one and the same species. Sadly, however, there seems little hope that this can ever be conclusively tested, because it is almost certain that Delcourt's giant gecko has been extinct for many years. How ironic, that a species as striking as this one should vanish into oblivion while a specimen was actually on public display for many years at a renowned natural history museum, with its significance being totally overlooked.

An update

However, the question now has to be asked - has this species really vanished? Wellington's *Dominion* newspaper reported on 11 September 1984 that local resident Dave Smith allegedly saw one of these geckos in the western region of North Island during the 1960s.

Also, following a New Zealand radio programme broadcast on 23 March 1990 in which this species' remarkable history was recounted by James Mack, assistant curator of New Zealand's National Museum, the museum was contacted by several people who claimed to have observed *living* specimens of Delcourt's giant gecko in recent times.

The eyewitness accounts included three independent, reliable reports all made at the same locality near Gisborne, on North Island's eastern coast. With its distinctive stripes, colouring and size, it is hard to believe that sightings could be confused with any other species of New Zealand lizard.



▲ Sightings were made in the vicinity of the coastal town of Gisborne.

New Caledonian giant forest geckos are very well-disguised. It is probable that Delcourt's giant gecko relied on camouflage to escape detection.



These, and various other reports, were followed up by herpetologist Anthony Whittaker and government scientist Bruce Thomas, but without success. Nevertheless, Whittaker believes that this species might still survive in the remote East Cape forests. Perhaps, after all, there will come a time when Delcourt's giant gecko will be known from more than just a single, long-forgotten stuffed exhibit?

Other accounts

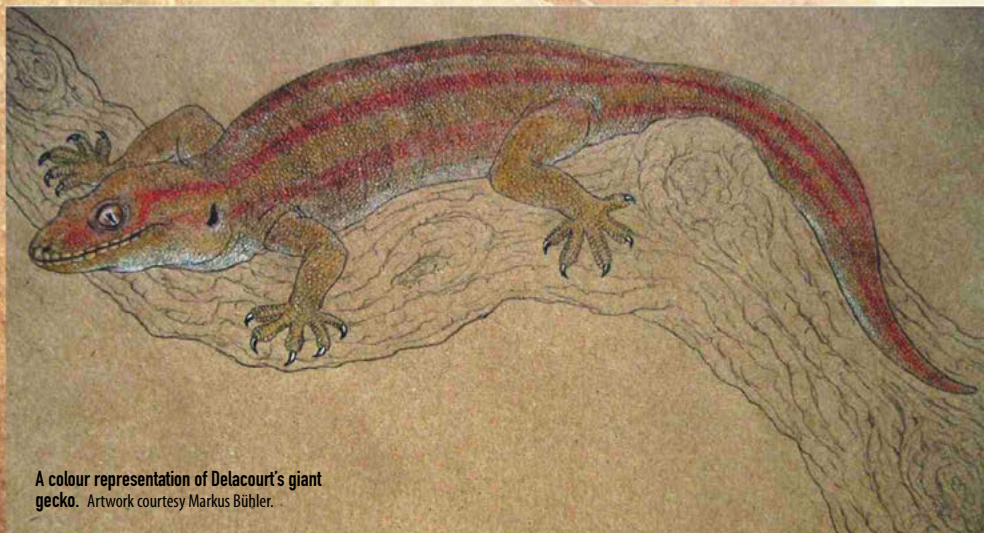
Moreover, the *kawekaweau* is not the only extra-large mystery lizard on record from New Zealand. Most famous are the *taniwha* – New Zealand's very own dragons, which have been likened both to gigantic geckos and even colossal tuataras, which resemble lizards but actually belong to a totally separate group of reptiles.

Tuataras themselves are endemic to New Zealand and are the sole survivors of an otherwise exclusively prehistoric reptilian lineage known as the sphenodontids. Their presence offers further evidence of the unique nature of New Zealand's herpetofauna.

The distinguishing feature of the *taniwha* is reputedly the presence of a row of long sharp spines along the centre of the back. The existence of the *taniwha* is still accepted even today by the Maori people, and these reptiles are said to possess formidable supernatural powers.

In 2002, a major highway in New Zealand had to be rerouted because of Maori claims that it would otherwise intrude upon the abode of a *taniwha*. Even more recently, in 2012, a similar objection arose in relation to the planned NZ \$2.6 billion construction of a tunnel in Auckland, with protestors claiming that this would disturb a *taniwha* that lived under the city.

These formidable creatures were said to inhabit dark, secluded localities on



A colour representation of Delcourt's giant gecko. Artwork courtesy Markus Bühler.



(even though these are not known to be native to New Zealand). Various *ngarara* are said to assume the form of a beautiful young woman on occasions (as reputedly could some *taniwha*).

Yet another giant mystery lizard of New Zealand is the *kumi*. Although occurring chiefly in Maori folklore, a real-life example was reportedly encountered near Gisborne in 1898 by a Maori bushman. He claimed that it was around 1.5m (5ft) long, and that it clambered up into a rata tree, leaving behind some footprints on the ground, which were apparently seen by other observers too.

A land fit for giants

Could it be that in bygone times, giant lizards really did exist in New Zealand, in a land famous for its absence of

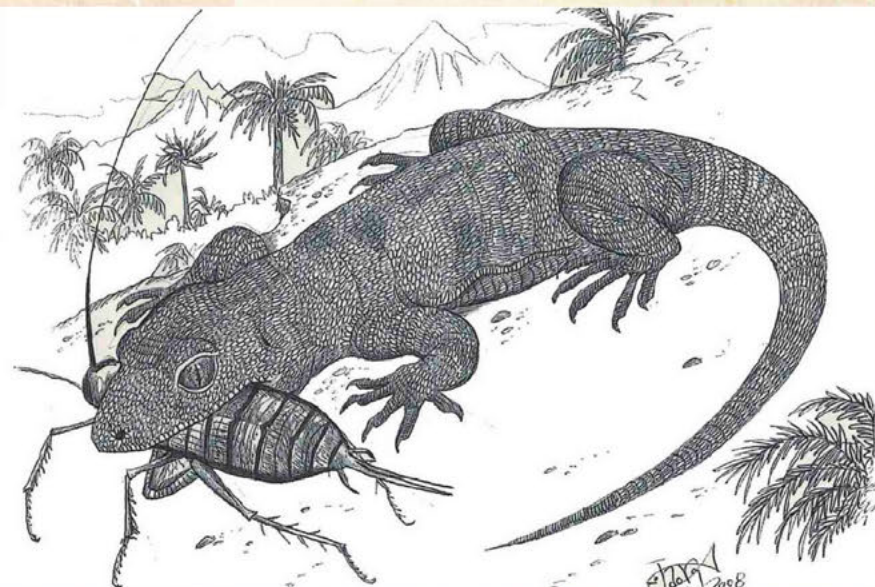
▲ A tuatara. Could this ancient group of reptiles be linked in some way with the *taniwha* legend? Was there once a larger species extant in New Zealand? Source PD.

terrestrial carnivores prior to humankind's introduction of rats, cats, and dogs? Certainly there was a vacant ecological niche for such an animal form, but without any physical evidence of their presence, such as preserved or skeletal remains, this intriguing line of speculation must remain exactly that – simply speculation.

► A carving of a *taniwha*. Source: PD.



◀ A representation of a *kawekaweau*. Image courtesy Justin Case.



land, as well as large freshwater pools. They could sometimes be encountered in the sea too, and were reputedly able to tunnel directly through the earth, often causing floods or landslides as a result. Each *taniwha* was allied to a specific Maori tribe that it protected, as long as it received a fitting level of respect and veneration, but it would often attack and devour members of other tribes.

Also present in Maori traditions are the *ngarara* – giant lizard-like land dragons seemingly resembling monitor lizards

An Asian perspective

On the subject of giant geckos, a very striking photograph has recently attracted appreciable attention on the internet, due to the fact that it seemingly depicts a gecko of truly gargantuan proportions - not so much a mega-gecko as a veritable giga-gecko! In reality, however, as I swiftly realised when observing it, what this photograph truly depicts is something very different from what it may initially seem to portray.

After conducting some online research, I was able to trace the source of the photo back to a couple of reports that appeared in the *Tribun Kaltim* newspaper on 5 and 6 May 2010. These sources claimed that the gigantic gecko, supposedly weighing a colossal 64kg (141lb), had been captured by a teenager in Nunukan, just inside the Indonesian region of Kalimantan on the border with the Malaysian state of Sabah, on the southeast Asian island of Borneo.

The reports also alleged that after many people had shown great interest in purchasing it, this stupendous lizard had finally been sold for the eye-watering sum of 64 million Malaysian ringgits (approximately 20 million US dollars) to an Indonesian businessman. He in turn had promptly exited Borneo with his purchase, taking it instead to Kuala Lumpur in Malaysia.

Since then, nothing more has been heard about this incredible creature – for a very good reason. The entire story was fictitious, and the photograph was an excellent example of optical trickery. Clearly, therefore, the giga-gecko was a



The giga-gecko's gigantic size is actually just an optical illusion, caused by it being very close to the camera. Source: *Tribun Kaltim*.

hoax, but who had perpetrated it? That remains a mystery.

The truth behind the story

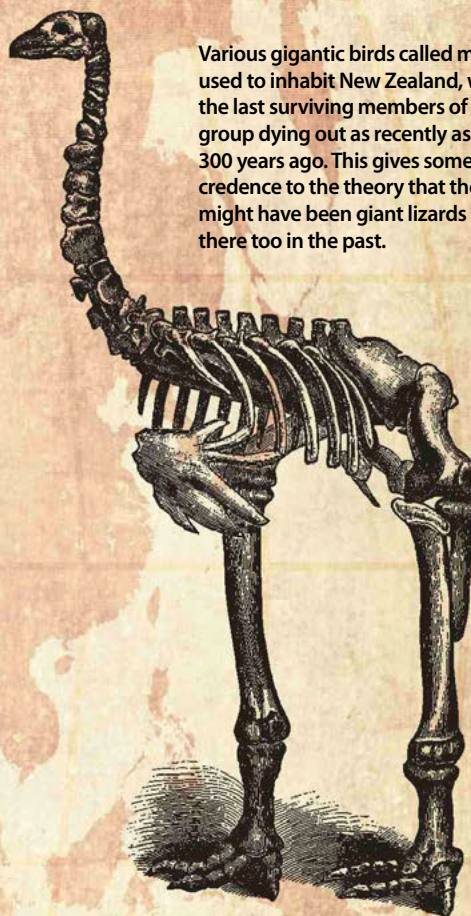
The gecko specimen in question is actually a very familiar, widely-distributed Asian species, the tokay gecko (*Gekko gekko*), which is instantly recognisable by virtue of its bluish-grey body, liberally patterned with bright red or yellow spots. Although the second largest species of gecko known to exist today, it is unlikely to exceed 30cm (12in) overall, and even the biggest specimens weigh no more than 0.4 kg (0.9lb).

The reason why the specimen in the photograph seems so enormous is that it is positioned very much closer to the camera than are the man and the cat sitting on (and under) the railing. This is a classic example of an optical illusion known as forced perspective, often seen in photographs and which, as effectively demonstrated here, can generate some very dramatic (as well as potentially deceiving) images when purposefully engineered.

The final nail in the coffin of this reptilian riddle was supplied when an inquisitive blogger named Abdul Wahid downloaded the gecko photograph directly from the *Tribun Kaltim* newspaper report. For as he revealed in a blog post at <http://ciucc.wordpress.com/2010/05/15/primacy-effect> on 15 May 2010, he duly discovered that it was encoded with information detailing that it had been edited using Adobe Photoshop software.

In short, this image was not only an example of forced perspective but had also been photo-manipulated on a computer. Exit the elusive – and definitely illusive – Indonesian giga-gecko!

** Dr Karl Shuker BSc PhD FRES FZS is a zoologist, author and broadcaster who is pre-eminent in the field of cryptozoology – the study of animals whose existence is not proven.*



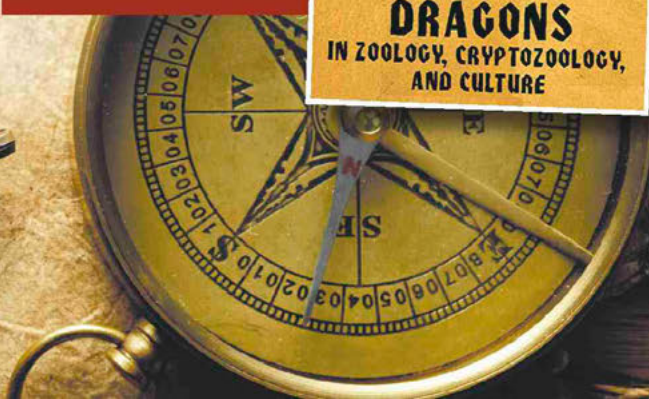
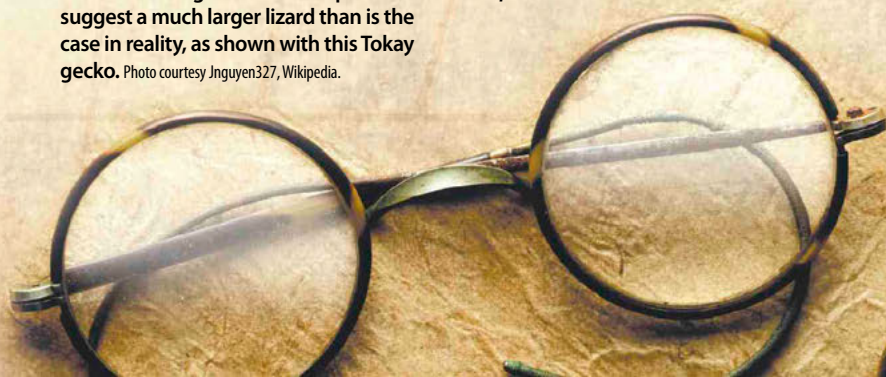
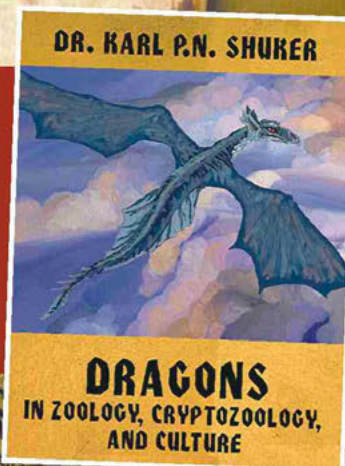
Various gigantic birds called moas used to inhabit New Zealand, with the last surviving members of this group dying out as recently as 300 years ago. This gives some credence to the theory that there might have been giant lizards there too in the past.



The camera angle can be manipulated to suggest a much larger lizard than is the case in reality, as shown with this Tokay gecko. Photo courtesy Jnguyen327, Wikipedia.

Want to know more?

Karl's book, entitled *Dragons in Zoology, Cryptozoology, and Culture*, is published by Coachwhip Publications (978-1616462154), and extends to 220 pages. It can be purchased from bookshops or online, and is priced at approximately £20.



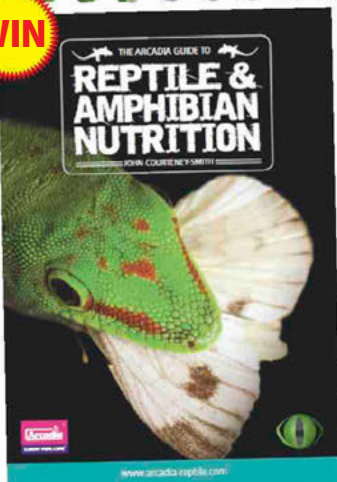
YOU & YOUR Reptiles



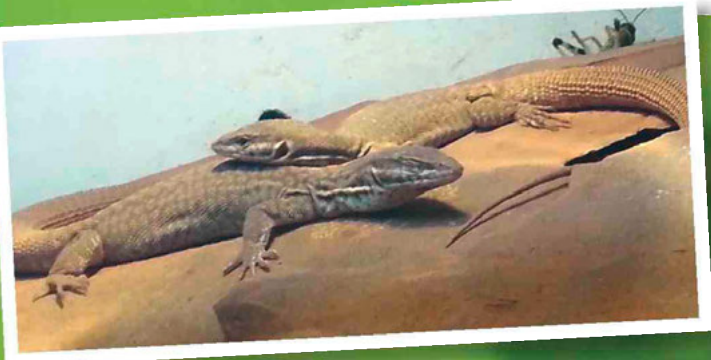
WIN

If you have a favourite photograph of one of your reptiles, amphibians or invertebrates which you'd like to see included in the magazine, then email us a **high resolution** digital image to **prk.ed@kelsey.co.uk**. Please include details about the subject, confirm anyone in the picture is happy for it to be published and that you took it.

Also, tell us where you live, because the best photograph, as judged by the *Practical Reptile Keeping* team, will win a prize. This month's winner will receive a personally signed copy of *The Arcadia Guide to Reptile and Amphibian Nutrition*, written by John Courteney-Smith. This ground-breaking 272 page colour book covers vitamin and mineral groups, uses and interactions; food categories; supplementation; gut flora and parasites; gut loading; livefood safety, nutrition and variety with 23 sources of livefood covered, plus much more!



Sten from Belgium sent this photo of his Horsfield's tortoise, who is six years old.



Two ackie or spiny-tailed monitors called Thor and Sif. From Simon in Coventry.

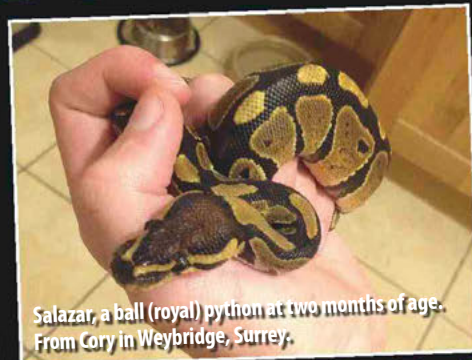
➤ Casper, a high translucent Yemen (veiled) chameleon. From Charlotte in Wragby, Lincolnshire.



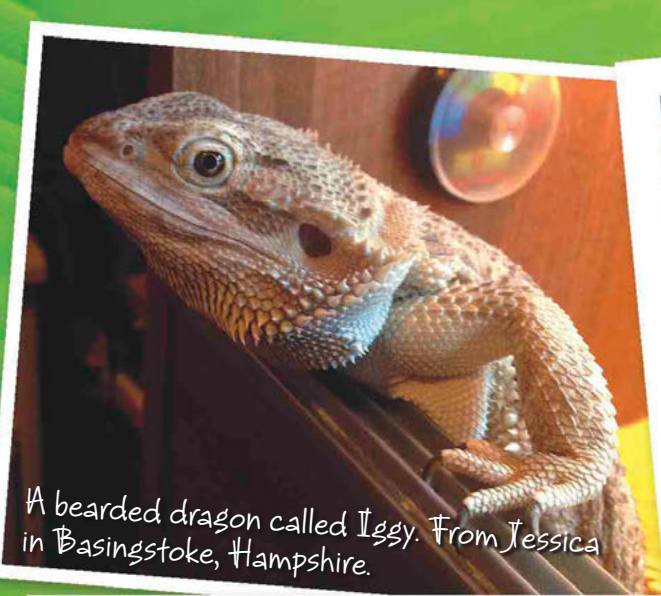
A White's tree frog called Lotad, in his new planted vivarium. From Alice in Ramsgate, Kent.



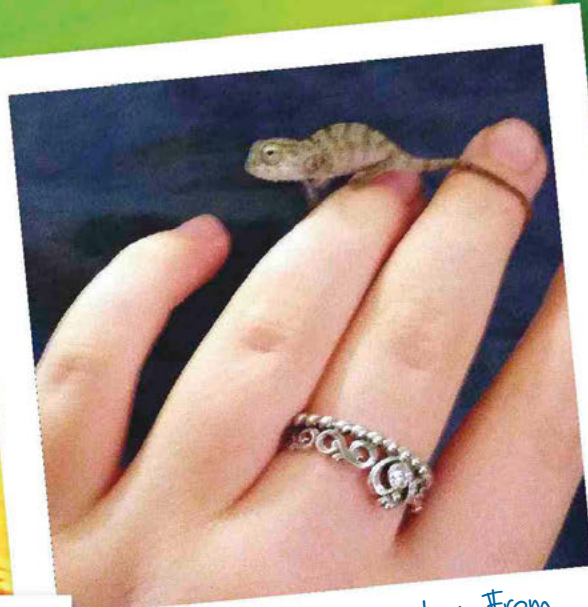
Dave, the bearded dragon, who recently passed away at 10 years of age, and is greatly missed. From Dan and Emma in Beeston, Leeds.



Salazar, a ball (royal) python at two months of age. From Cory in Weybridge, Surrey.



A bearded dragon called Iggy. From Jessica in Basingstoke, Hampshire.

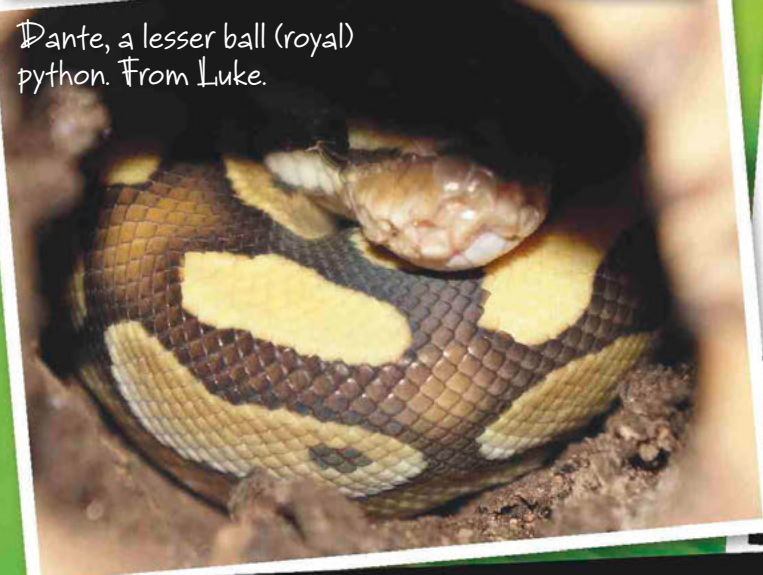


A week old panther chameleon. From Charlotte in Wragby, Lincolnshire.

Norbet, the bearded dragon, having his first bath. Sent in by Lauren from Chester.



Grey-banded kingsnake. Sent in by Luke from Towcester, Northamptonshire



Dante, a lesser ball (royal) python. From Luke.



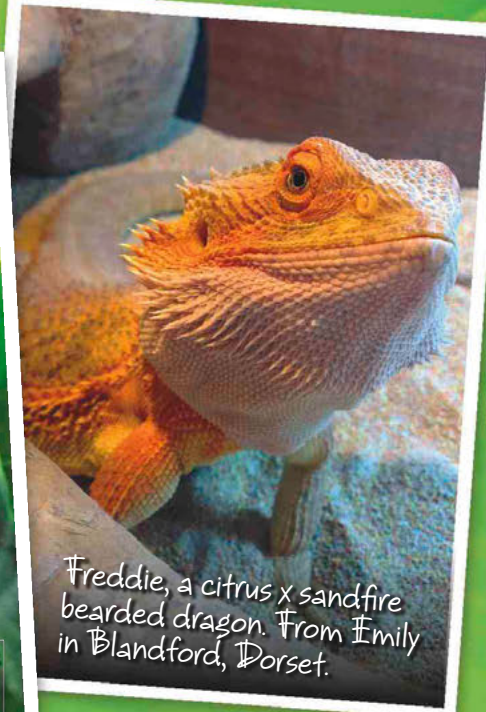
A six week old blue bar Ambilobe chameleon shedding. From Charlotte in Wragby, Lincolnshire.



Asian box turtles from chenychi168.



Asian long-tailed lizards called Christine and Kate. From Martin in Glasgow.



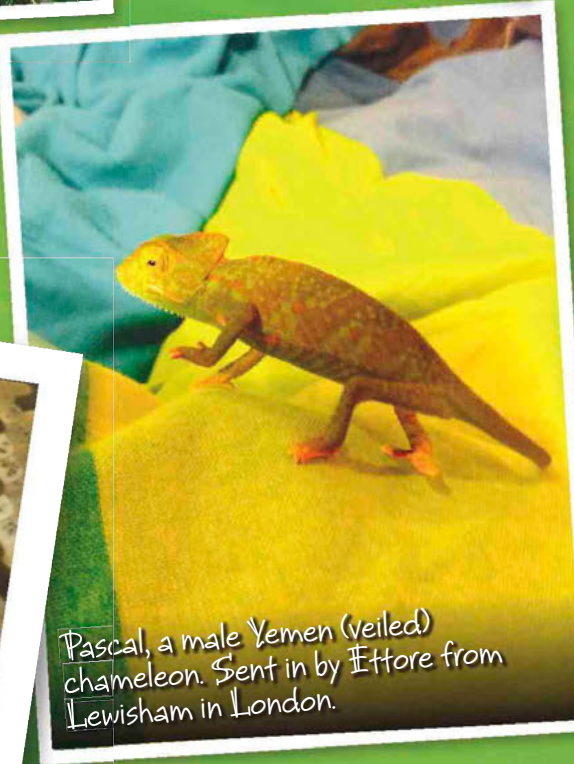
Freddie, a citrus x sandfire bearded dragon. From Emily in Blandford, Dorset.



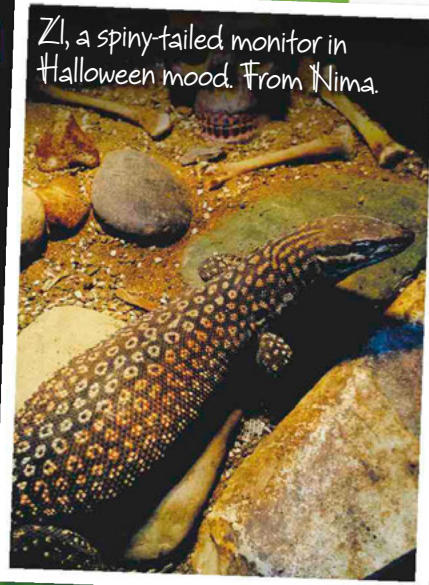
◀ A Yemen (veiled) chameleon called Pascal, who is a year old. Sent in by Pete from Peterborough.



Archie - a Burmese python four years old and almost 3m (10ft) long. From Luke in Northamptonshire.



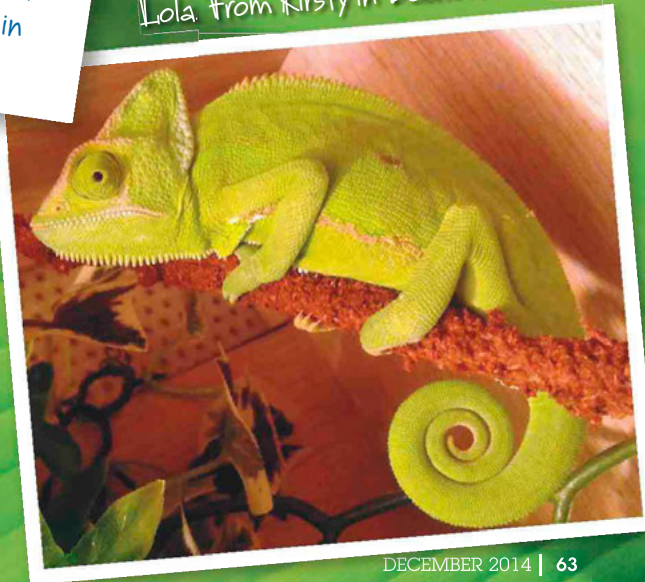
Pascal, a male Yemen (veiled) chameleon. Sent in by Ettore from Lewisham in London.



Zl, a spiny-tailed monitor in Halloween mood. From Nima.



Ozi the bearded dragon, who is three years old. From Nima in London.



✓ A Yemen (veiled) chameleon called Lola. From Kirsty in Bedfordshire.

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. Next month.

NIGHT-TIME GECKOS



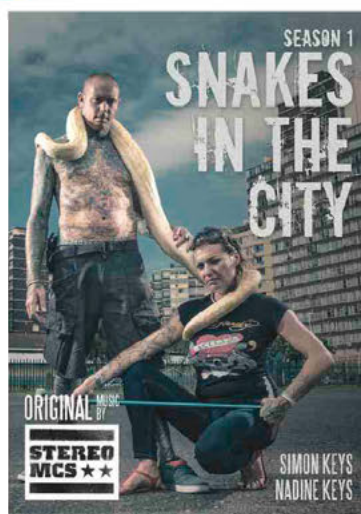
Phil Purser looks at a number of the popular arboreal species in this category, including the Moorish, Indonesian skunk and tokay geckos, as well as a number of others from the Indo-Pacific region. He highlights the differences between them, and outlines their care and breeding.



In the January **Practical Reptile Keeping** issue

STAY SAFE!

Don't miss our exclusive interview with professional snake catcher Simon Keys, who with his wife Nadine stars in the National Geo television series, *Snakes in the City*. Together, they battle to keep Durban's homes free from deadly snakes, moving them to more suitable surroundings.



HONEYCOMB SOLUTION:

1. ROGERS, 2. MOORED, 3. MERINO, 4. NICKEL, 5. FEMALE, 6. GAMBLE.
CENTRAL WORD: LAGOON

REPTILE ID SOLUTION:

THIS SPECIES IS KNOWN UNDER A VARIETY OF COMMON NAMES, INCLUDING THE GREATER OR MASKED SPINY LIZARD; THE BLACK-FACED LIZARD AND THE ARMOURD PRICKLENAPE (*ACANTHOSAURA ARMATA*). IT AVERAGES ABOUT 30CM (12IN) IN TOTAL LENGTH WHEN ADULT, AND OCCURS IN SOUTHEASTERN ASIA, BEING PRESENT IN PARTS OF THAILAND, MALAYSIA, INDONESIA, BURMA AND CHINA. THESE LIZARDS ARE ARBOREAL BY NATURE, AND HUNT INVERTEBRATES AND THEY SOMETIMES PREY ON SMALL FISH TOO. THEY ARE AGILE AND FAST-MOVING.

TORTOISES AND CONTINENTS SOLUTION:

1. SOUTH AMERICA – YELLOW-FOOTED TORTOISE (*GEOCHELONE DENTICULATA*).
2. AFRICA – BELL'S TORTOISE (*KINIXYS BELLII*).
3. EUROPE – HERMANN'S TORTOISE (*TESTUDO HERMANNI*).
4. ASIA – ELONGATED OR YELLOW TORTOISE (*INDOTESTUDO ELONGATA*).

LINKAGE SOLUTION:

THEY ALL FEATURE THE WORD 'GOPHER' IN THEIR COMMON NAME. THEY ARE THE GOPHER TORTOISE (*GOPHERUS POLYPHEMUS*), THE COMMON GOPHER SNAKE (*PITUOPHIS CATENIFER*) AND THE RODENT SIMPLY KNOWN AS THE GOPHER. IN ADDITION, THEY ALL ORIGINATE FROM NORTH AMERICA AND SPEND A VARYING AMOUNT OF THEIR LIVES UNDERGROUND IN BURROWS.

COUPLETS SOLUTION:

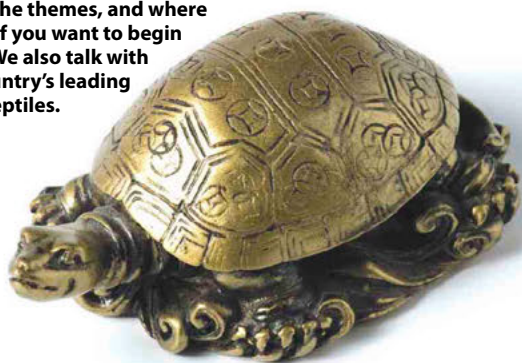
SHANDY, COWARD, BRUTAL, ENERGY, SELDOM, IDLING, THE LIZARD IS: HORNED DRAGON

PLUS ALL OF OUR REGULAR FEATURES

including veterinary care with Joanna's Casebook, Out of Africa, Herpetological Mysteries, You & Your Reptiles, plus Tales from the Reptile House.

REPTILES IN ART

There's a growing interest in art involving reptiles, but what are the themes, and where can you start if you want to begin a collection? We also talk with one of the country's leading sculptors of reptiles.



*These are just some of the features planned for the next issue but circumstances outside our control may force last-minute changes. If this happens, we will substitute items of equal or greater interest.

Practical Reptile Keeping and the Pet Advertising Advisory Group recommend that if you decide to buy a reptile or amphibian, you should:-

- * **RESEARCH BEFORE YOU BUY.** Be sure you fully understand and appreciate the needs of the reptile or amphibian you are interested in, and that you can provide a suitable environment.
- * **SEEK ADVICE FROM BOOKS,** the internet and your local veterinary practice who may also be able to recommend a suitable expert for additional advice.
- * **ENSURE YOU KNOW** what facilities are necessary to provide a suitable environment for the animal – e.g., vivarium, temperature, humidity, light quality etc..

- * **ENSURE YOU BUY** from someone who specialises in the animal you are interested in.
- * **VISIT THE ANIMAL** you are intending to buy.
- * **CHECK THAT THE ANIMAL'S** accommodation is clean, it is supplied with the appropriate food and water, and that special equipment for maintaining the animal's environment (e.g., heat lamps or UV lights, etc) is working properly.
- * **ENSURE THAT ALL RELEVANT PAPERWORK IS AVAILABLE FOR INSPECTION WHEN YOU VISIT.** This could include any necessary permits such as CITES

registration documents, Dangerous Wild Animals Licence or other documentation.

- * **IF ANY PAPERWORK IS UNAVAILABLE** and has to be sent on, obtain a written commitment as to when it will be delivered.
- * **ENSURE THAT THE ANIMAL YOU ARE BUYING** is healthy and free from signs of injury or disease.
- * **REMEMBER THAT SOME REPTILES CAN GROW VERY LARGE** and some species can live for 50 years or more. Veterinary care can be very expensive.

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Cudham Tithe Barn, Berry's Hill,
Cudham, Kent TN16 3AG
Telephone: +44 (0)1959 541444
Fax: +44 (0)1959 541400

EDITORIAL

Editor: David Alderton
Email: prk.ed@kelsey.co.uk
Art Editor: Rob Terry
Email: rob@focusedondesign.co.uk

ADVERTISEMENT SALES

Talk Media Sales
01732 445325
prk.ads@kelsey.co.uk
Group Sales Director:
sally.barton@kelsey.co.uk

PRODUCTION

Deputy Production Manager:
Charlotte Whittaker 01733 353367
charlotte.whittaker@kelsey.co.uk
Production Manager: Karen Wayman
karen.wayman@kelsey.co.uk

SUBSCRIPTIONS

Subscriptions Marketing Manager:
Daniel Webb

Newstrade Circulation: Eleanor Brown

MANAGEMENT

Managing Director: Phil Weeden
Chairman: Steve Annetts
Chief Executive: Steve Wright
Finance Director: Joyce Parker-Sarioglu
Head of Audience Development: Andy Cotton
Creative Director: Vicky Ophield
Brand Marketing Manager: Rebecca Gibson

CIRCULATION DEPARTMENT

Subscriptions

UK new subscriptions orderline:

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UK new subscriptions renewals:

0845 450 1019

UK customer services: 01858 438 857

UK fax: 01858 469 804

UK postal address:

Freeport RSXY-XXGK-EUYS
Kelsey Media, Market Harborough LE16 9EF

Overseas order hotline:

+44 (0) 1858 438856

Overseas customer services:

+44 (0) 1858 438857

International fax:

+44 (0) 1858 469 804

Overseas postal address:

Kelsey Media, Unit 4, Tower House,
Sovereign Park, Market Harborough
LE16 9EF, UK

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